APRIL 1954

PRECISION METAL MOLDING

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS
INVESTMENT CASTINGS
POWDER METALLURGY
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Our new modern alloy plant is now producing quality controlled ZAMAK zinc alloys. Its production will add to the total output of our Cleveland plant and will enable us to provide prompt nationwide service on all requirements. For dependable deliveries of uniform ingots in any quantity, phone or write to

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For Die Casting, Permanent Mold and Sand Casting

Whatever casting process you use you'll get sounder, more uniform castings when you use White Star brand quality controlled aluminum alloys. Quality is always uniform, a complete metallurgical laboratory and skilled technicians using the finest techniques and latest devices obtainable double check each melt to guarantee that each ingot meets your specific requirements. For top quality ingots and prompt service write or phone

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DIE SET-UP

Easier! Faster! Safer!...

WITH

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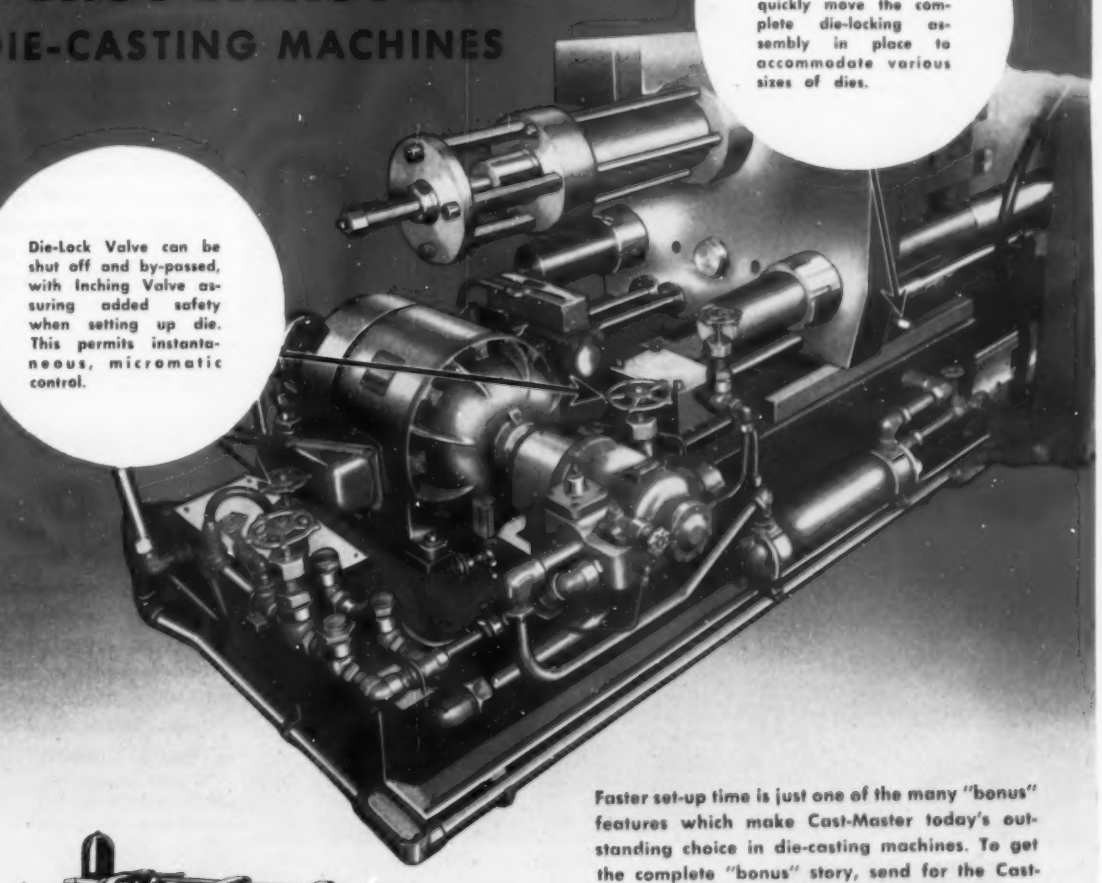
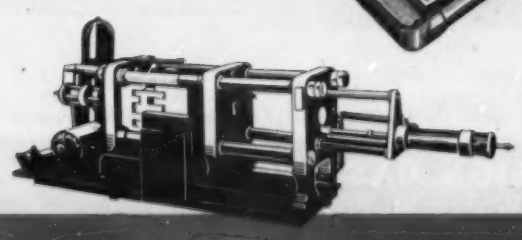
DIE-CASTING MACHINES

Built-in Rack and Pinion permits use of a ratchet wrench to quickly move the complete die-locking assembly in place to accommodate various sizes of dies.

Die-Lock Valve can be shut off and by-passed, with Inching Valve assuring added safety when setting up die. This permits instantaneous, micromatic control.





Faster set-up time is just one of the many "bonus" features which make Cast-Master today's outstanding choice in die-casting machines. To get the complete "bonus" story, send for the Cast-Master catalog, containing illustrations and specifications on eight new models.

SEND FOR CATALOG TODAY!

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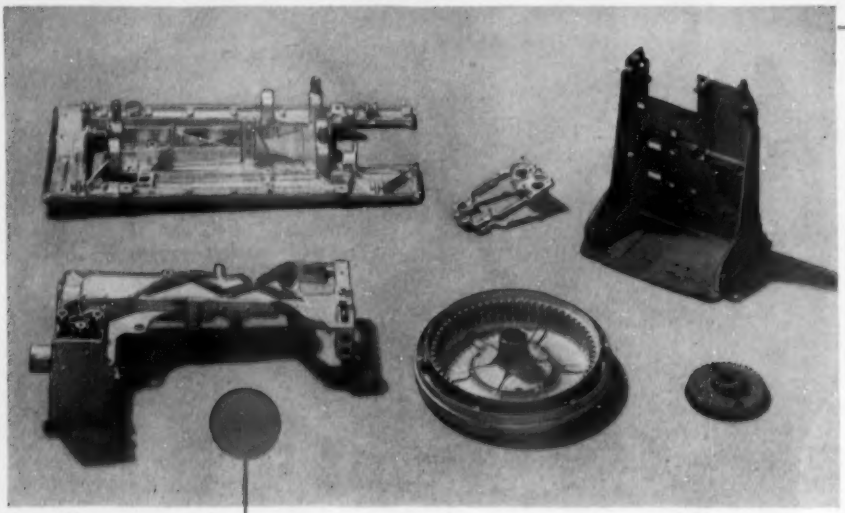
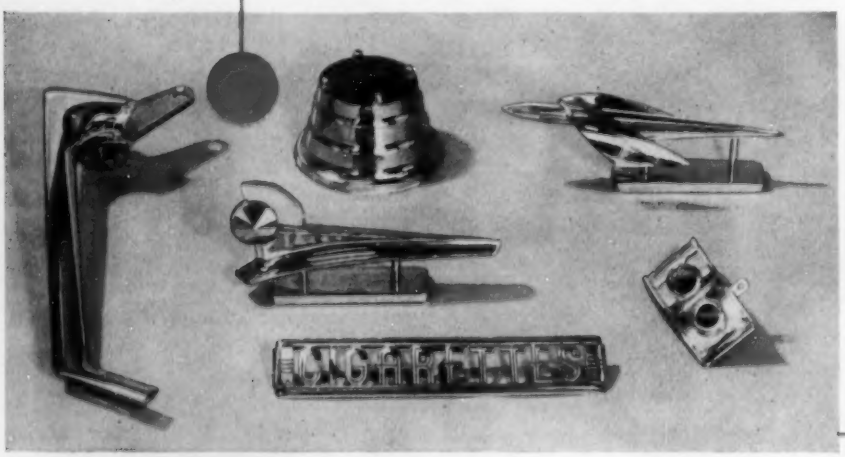
No Problem's Too Tough *when you call in* ... PRECISION



CLOSE TOLERANCES

Precision has demonstrated outstanding ability to produce die castings to extremely close tolerances through rigid production control. This often results in substantial reduction or elimination of subsequent machining operations . . . in fact, many parts can be used "as cast."



FINISHING

Precision die castings can be painted, oxidized, plated or self finished by polishing. Precision can finish in any manner including precious metal plating. Complete plating and finishing facilities at the Kalamazoo, Mich. and Syracuse, N. Y. plants.

Since 1909 the name "PRECISION" has been the symbol of highest quality in the die casting industry.

PRECISION CASTINGS CO., Inc.
212 Walnut St., Fayetteville, N. Y.
Syracuse, N. Y. · Cleveland, O. · Chicago, Ill.
Kalamazoo, Mich. · Cortland, N. Y.
British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

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APRIL 1954
Vol. 12 No. 4

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PERMANENT MOLD CASTINGS • POWDER METALLURGY • SHELL MOLDINGS

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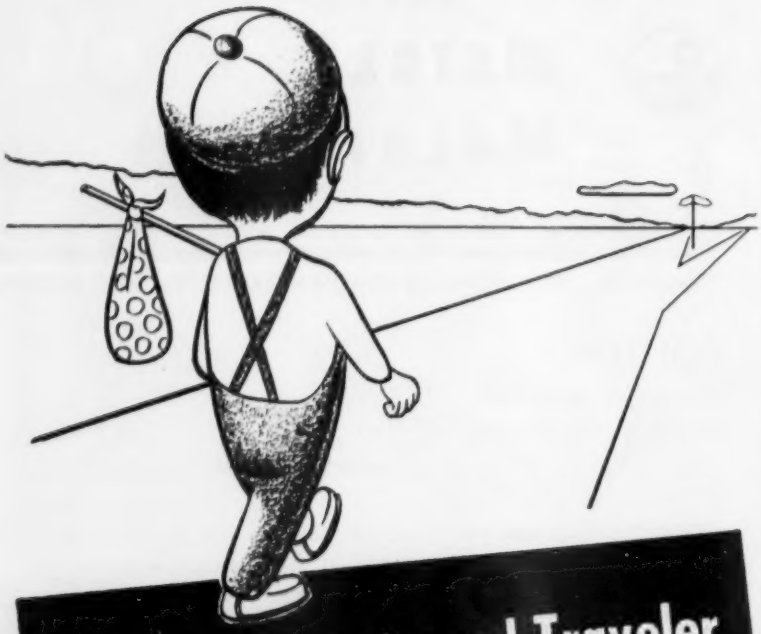

Only An Experienced Traveler Knows The Best Road . . .

. . . so why not take advantage of our vast experience in the production of zinc and aluminum die castings.

We have produced die castings for more years than we care to think about, and have made parts for everything from baby carriages to casket hardware, from an automobile to a portable tool.

In other words, why don't you benefit from what we have learned by producing zinc and aluminum die castings? It is bound to save money for you, get the job out faster and better.

As a service, we have prepared this guide book, "Dimensioning Die Castings." Send for your free copy.

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Producers of highest quality zinc and aluminum die castings

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Letters to the editor

METALLIC SEALING

I am interested in learning more about the metallic sealing compounds used in production sealing of castings such as was covered by the article on page 59 of your January issue.

We would like to know the address of the Tincher Products and would appreciate it if you would supply it, or better still, could you mail this letter direct to them and I am sure they would be glad to tell us something about methods, costs, etc.

We are presently doing work in the impregnation and baking of electrical coils and have some equipment that we feel may be adaptable to the preservation of castings. — T. T. L.

We have read with interest the article on Production Impregnation" in the January 1954 issue of "Precision Metal Molding."

We are interested in obtaining a water-washable plastic sealant that does not require refrigerated storage and will appreciate your sending us the names of manufacturers who will supply such a material. — L. V. (Process Engineer)

The above letters are typical of those showing interest in impregnation. While we cannot give detailed technical data about each of the several impregnating processes and materials, we have sent names of manufacturers who are able to answer specific questions. — Ed.

continued on page 6

Dead weight means less freight for truckers . . .

So Trailmobile **saves 140 pounds** on "props" with **ALUMINUM INDUSTRIES** Castings

● Famous Trailmobile Trailers are engineered in minute detail to obtain the highest possible strength-to-weight ratio. In keeping with their strong, lightweight aluminum bodies, quarter panels and structural members, Trailmobile uses aluminum "props" that are sand cast in the foundries of Aluminum Industries, Inc.

These Permite aluminum castings have the structural soundness and high strength to support heavy loads, yet weigh but *30 pounds each*. That's a clean saving of 140 pounds of dead weight on the two "props" . . . important to the truck driver who must raise the "props" up into traveling position before getting underway . . . important to the truck owner because every pound of dead weight saved gives him extra payload.

Why not check over the components of your product? Perhaps there are parts which could be cast in aluminum by Aluminum Industries, Inc., to give *you* a lighter. more efficient assembly — or a more attractive, more saleable product. Recommendations by Aluminum Industries engineers have helped manufacturers in widely varying fields to obtain these objectives.

Recommendations and cost estimates on your parts requirements are yours for the asking.

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PERMITE Aluminum Castings

ALUMINUM PERMANENT MOLD and SAND CASTINGS . . . HARDENED, GROUND and FORGED STEEL PARTS

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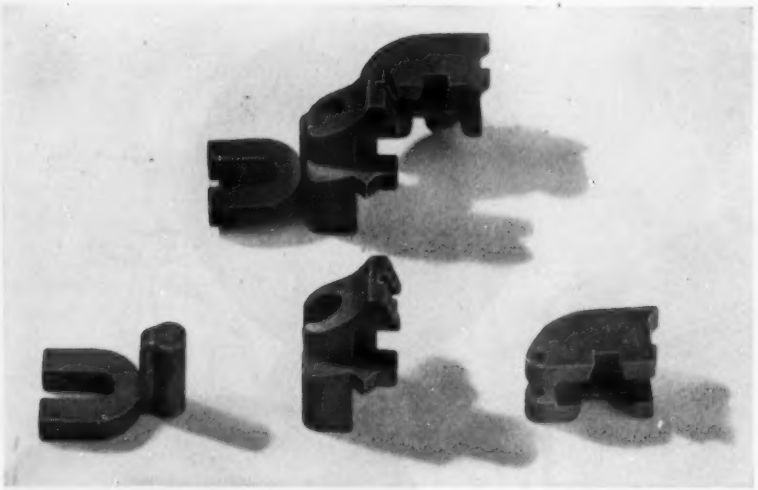

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For Highest Quality, Lowest Cost Investment Castings

A successful producer of investment castings tells us that he recommends BERYLCO parts to his customers wherever possible. The material casts so beautifully and keeps rejections so low that the delivered BERYLCO part usually carries a lower price than the same item cast from a cheaper, less serviceable material.

The standard beryllium copper alloy supplied to the investment trade is BERYLCO 20CR. Close metallurgical control is applied in all stages of manufacture so as to assure consistency of analysis, superior foundry characteristics, and the ability to be hardened to strengths far in excess of brasses and bronzes. Convenient ingot sizes—3 ounce, 2½ pound and 5 pound—are available for quick shipment. Most orders filled on a 48-hour basis.

Should you wish to get started with BERYLCO, drop us a line. Trial samples and technical assistance are yours for the asking.

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LETTERS TO THE EDITOR
continued from page 4

VACUUM CASTING

We are writing you in order to obtain information regarding casting equipment.

We are specifically interested in securing a list of manufacturers of vacuum precision casting equipment for use with OFHC copper. — J. C. S. (Division Purchasing Agent).

Names of sources have been forwarded — Ed.

WELDING ALUMINUM DIE CASTINGS

I am especially interested in your article on welding aluminum Die Castings, pages 34-35, January 1954. I am of the belief that the exact procedure used in welding the dental equipment can be applied to my welding problem. — G. L.

A more complete summary of the welding process at The Ritter Company has been forwarded. A successful job of welding aluminum die castings is being done there on a production basis. — Ed.

BRASS DIE CASTING MACHINES

We represent an Austrian firm in the Western Hemisphere and have been requested to obtain names and addresses of US manufacturers of Brass Pressure (Injection) Die Casting Machines.

Please advise us who manufactures these machines. — V. O. (Exec. Vice President).

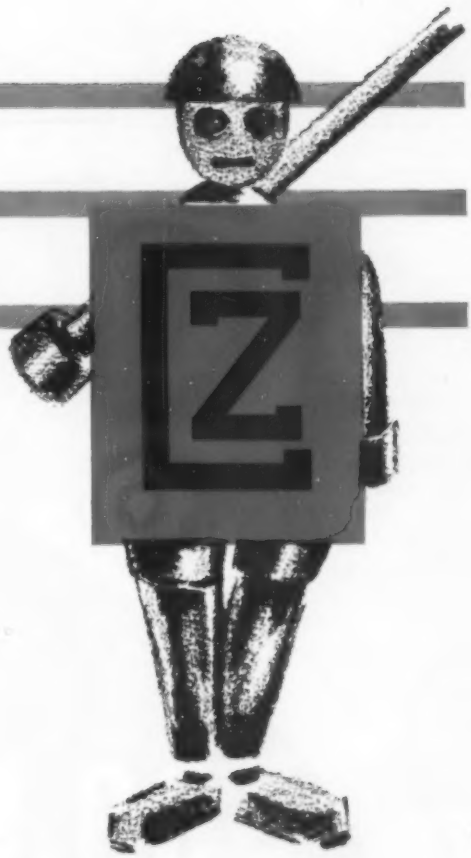
Brass is die cast in cold chamber machines, in the same manner as aluminum and magnesium. Names of manufacturers of this equipment have been forwarded. — Ed.

NICKEL-CADMIUM BATTERIES

Would you be kind enough to send us a copy of your publication "Precision Metal Molding" of August 1952. We are particularly interested in the article about the characteristics of nickel cadmium batteries. — S. T.

Copy sent — Ed.

GUARDING THE QUALITY OF *YOUR* ZINC DIE CASTINGS



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Advance Pressure Castings, Inc., Brooklyn, N. Y.
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Dollin Corporation, Irvington, N. J.
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Federal Die Casting Company, Chicago, Ill.
Globe Imperial Corporation, Rockford, Ill.
C. M. Grey Mfg. Co., East Orange, N. J.
Heick Die Casting Corp., Chicago, Ill.
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Mt. Vernon Die Casting Corp., Mt. Vernon, N. Y.
Paragon Die Casting Company, Chicago, Ill.
Parker White Metal Co., Erie, Pa.
Precision Castings Company, Inc., Fayetteville, N. Y.
Precision Castings Company, Inc., Cleveland, Ohio
Precision Castings Corp., Chicago, Ill.
Pressure Castings, Inc., Cleveland, Ohio
Racine Die Castings Co., Racine, Wis.
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At no extra cost, you enlist the services of an extra guardian when you have your die castings made by one of the listed die casters, licensed CZ producers.

Under the **Certified Zinc Alloy Plan,** your die castings are subject to periodic, searching scientific scrutiny to make certain that they are *on grade,* that the alloy meets the specifications *you* set.

CZ stands guard on your every job to make sure that each and every one of your die castings is of a consistently superior quality.

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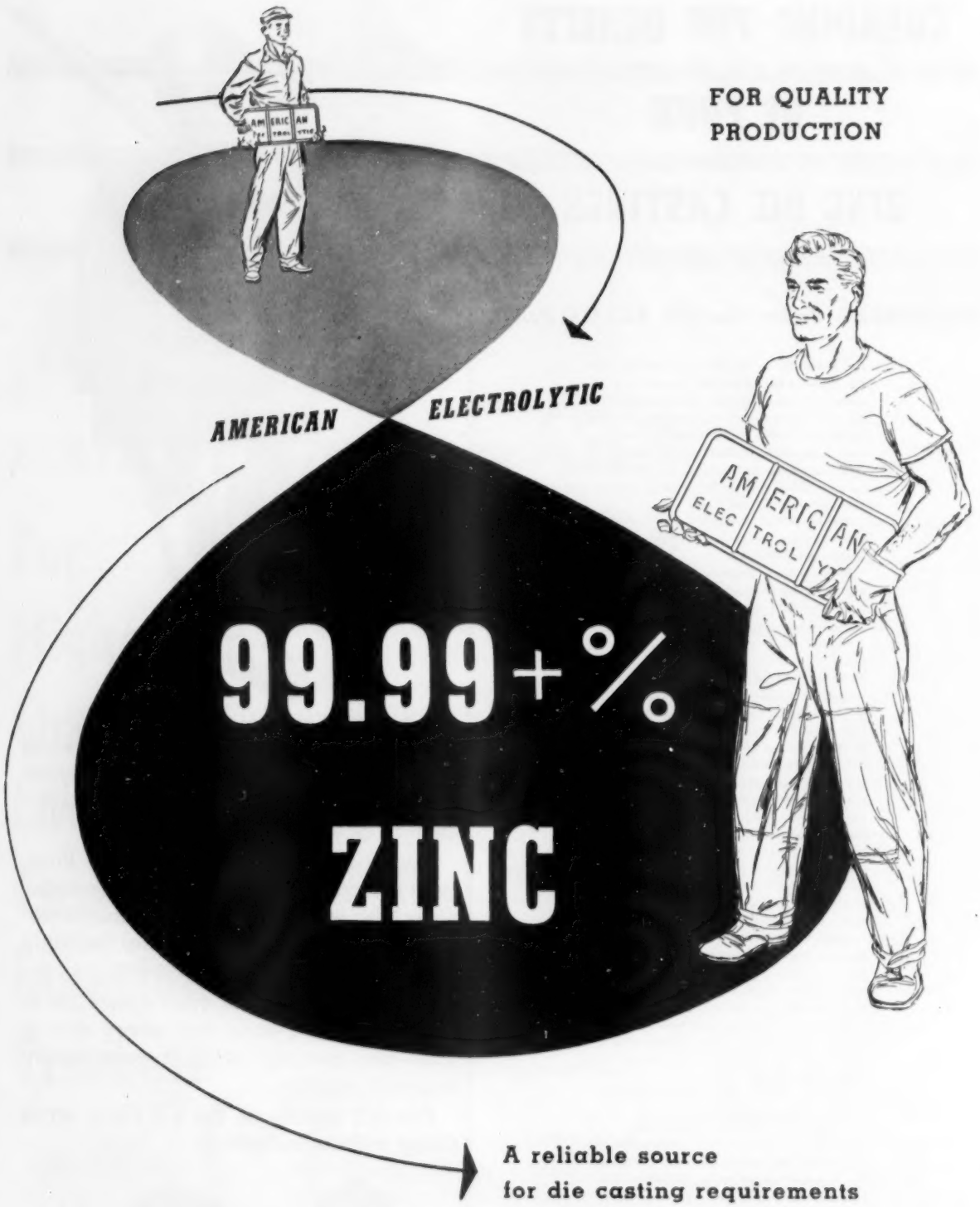

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Where do the old timers go?

If they are the "old time" mold and die makers, they have probably gone to Phoenix, Arizona to enjoy retirement in the wonderful Phoenix climate. And chances are that after a few months of fun-in-the-sun, they are anxious to get back to work and turn their hands once again to their old skills.

That's why Phoenix is today one of the great centers of skilled mold and die makers — men who are still able to turn out a full day of careful and exacting work — men who take justified pride in the skills they've acquired in a lifetime of work and experience.

That's why Phoenix was selected as the site of operations for BEE Mold and Die, Inc. — custom-manufacturers of molds and dies. For BEE knows that only the superior abilities of these experienced craftsmen can produce the perfectly made molds and dies that you demand.

MEETING INDUSTRY'S NEEDS

BEE Mold and Die, Inc., meets the needs of rubber, plastics and metal casting industries by providing them with a dependable source of molds and dies accurately made to the most exacting specifications.

BEE is devoted exclusively to the custom-manufacturing of molds and dies — their entire effort is devoted to this single task—they do nothing but design and produce molds and dies for you — they have no other interests.

BEE operations are thoroughly integrated and subject to minute control. For example, they even do their own engraving.

BEE provides you with the services of the most modern equipment *plus* the services of capable engineers and skilled craftsmen — you can be assured of guaranteed quality and workmanship in the production of your molds and dies.

Take your next mold or die problem to BEE for fast, dependable and economical service. We ship *F.O.B. your plant.*

Our nation-wide staff is ready to serve you. Write, wire or phone us at Phoenix or at our nearest branch office. We welcome the opportunity to quote on your needs in molds and dies.

Bee

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PHOENIX, ARIZONA
BRIDGE 5-5753

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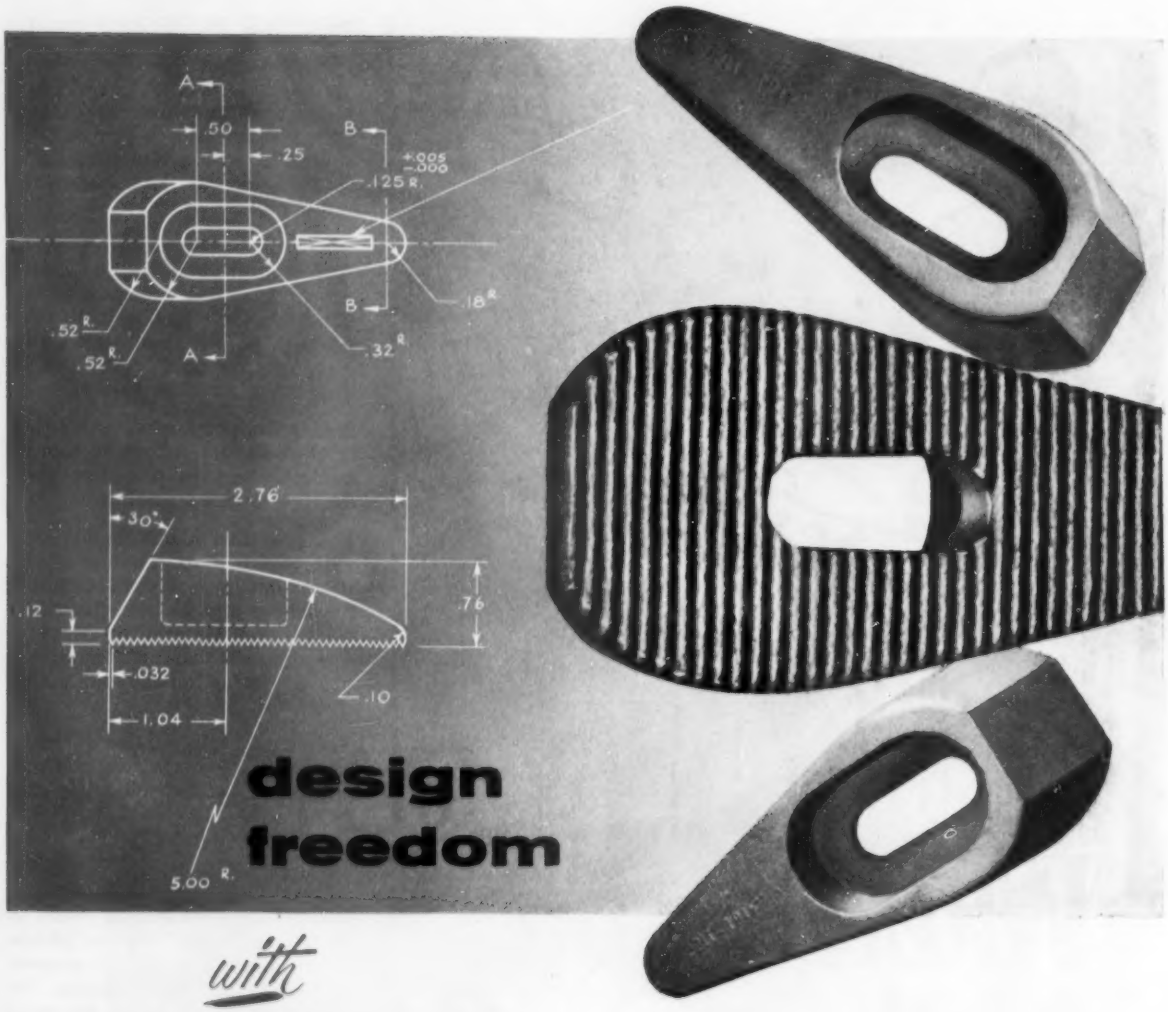

with

CRUCIBLE ACCUMET PRECISION INVESTMENT CASTINGS...

Here's another good example of how Accumet Precision Investment Castings help put an end to design problems.

To machine the curved and tapered surfaces, elongated hole and counterbore, and serrations on this AISI 4140 alloy steel aircraft part, would have been too costly to be practical. But the parts were quickly and economically produced by investment casting.

More and more parts are being *designed* specifically for the investment casting process. And there are good reasons why. Crucible Accumet Precision Castings allow the greatest freedom of design. Intricately shaped parts can be made of any grade of steel, including high-alloys, in large quantities and at low cost.

It will pay you to let your local Crucible representative give you the whole story of how Accumet Precision Castings can help you produce a better product at lower cost.

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54 years of Fine steelmaking **ACCUMET PRECISION CASTINGS**

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ZINC
ranks first in Die Casting

Zinc alloys are used to the extent of about two-thirds by weight of all die cast parts consumed annually in the United States. The comparatively low melting point of zinc makes it possible to produce die castings at a speed which cannot be attained with alloys based on other commonly available metals. The lower casting temperatures of zinc base alloys are also responsible for considerable savings in fuel cost, die cost and die maintenance.

Zinc alloy castings are stable, strong and rate highest in dimensional accuracy. The remarkably smooth surfaces obtained with zinc alloys in the "as cast" condition, keeps finishing work to a minimum. Frequently, only buffing is necessary prior to plating or for the application of other types of finishes. Due to the high fluidity of zinc alloys at casting temperature, die castings of highly complex design needing little or no machining can be readily produced.

The relative market value of the metals commonly used in die casting is not the only factor in choosing alloys for die castings. Production costs may counteract the difference in the metal cost.

DIE CASTING is the Process ● ZINC, the Metal ● BUNKER HILL, the Preferred Zinc

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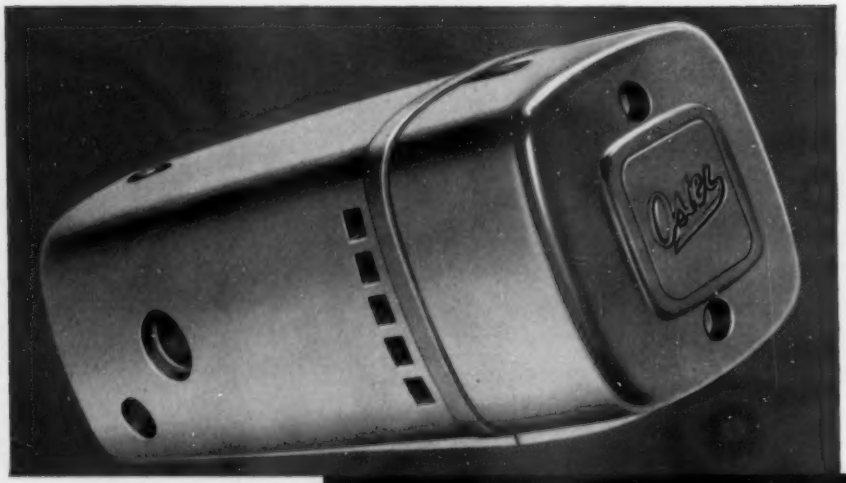
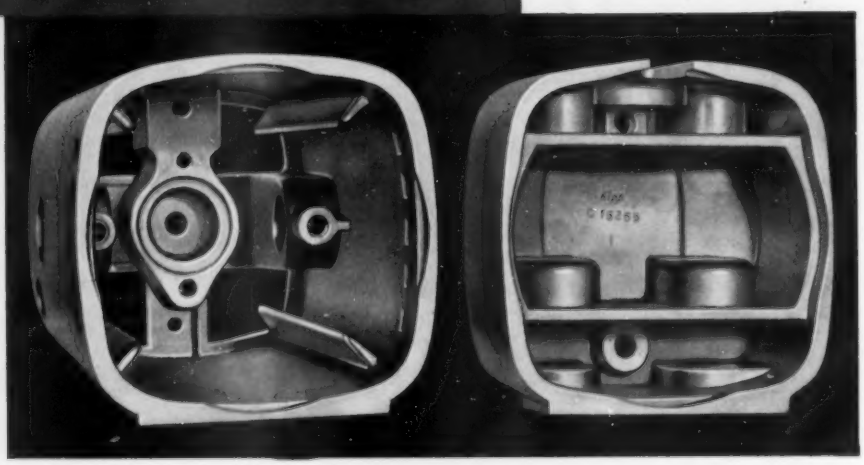


the OUTSIDE for eye appeal

the INSIDE for function



...with MADISON-KIPP zinc and aluminum die castings

Any designer will be intrigued by studying these new popular kitchen mixer parts by Oster. The outside is shaped to suit a famous designer for "looks". The inside accepts the "works" designed by the inventive engineers.

You also may be able to add sales value without cost penalty by letting Madison-Kipp work with you on your new designs.

kipp

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213 WAUBESA STREET • MADISON 10, WIS., U.S.A.

• Skilled in Die Casting Mechanics • Experienced in Lubrication Engineering • Originators of Really High Speed Air Tools

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HAMILTON ART METAL CORP. plans to use *LINDBERG-FISHER* melting furnaces exclusively

The Hamilton Art Metal Corporation, New Hyde Park, New York, has equipped five die casting machines with Lindberg-Fisher, 40 KW, two chamber induction melting and holding furnaces for aluminum. Each furnace was purchased, one by one, based on the excellent performance of previous units. Noted for the quality of its intricate castings, this job die casting plant has increased production 38% and cut rejects to the bone by using the Lindberg-Fisher principle of induction melting.

The term "satisfaction" would be a gross understatement as reflected in the words of Mr. Eric Wedemeyer, President, who says:

"I am making plans for the day when our plant will be 100% Lindberg-Fisher equipped. If it were not for local power limitations, we would immediately replace the fuel fired equipment we are forced to partially use in favor of additional induction equipment designed by Lindberg-Fisher. Improved operator working conditions have brought our personnel turnover to a stand-still.

In my opinion Lindberg-Fisher furnaces are head and shoulders above other methods of melting found in the field of die casting today."

You'll increase production. You'll reduce rejects. You'll improve working conditions. The famous Lindberg-Fisher 2-chamber construction does the trick.

Two-chamber construction gives you cleaner molten metal and permits continuous ladling. Cold metal can be added to the charging chamber without affecting temperature of ladling chamber. Scrap can be re-charged thereby eliminating handling and identification problems.

Two-chamber construction permits cooler working conditions. Induction heating heats only the metal, not the entire furnace. There are no flames—no products of combustion. Only a comparatively small area of molten metal is exposed to the operator.

Ask for a copy of bulletin 560 "Lindberg-Fisher two-chamber melting furnaces."

LINDBERG-FISHER MELTING FURNACES

Lindberg Engineering Company • 2463 West Hubbard Street • Chicago 21, Illinois

For additional information Circle No. 59 on the Reader Service Card

Changes in personnel

IRA C. MATTHIESSEN has been named district sales manager for the *Columbia Tool Steel Co.* southern California territory.

A. T. OLSSON has been appointed assistant to the sales manager, *Acheson Colloids Co.*

CARL J. DEMRICK has been elected vice president in charge of manufacturing of *Plymouth Motor Corp.*

GEORGE SATHRE has been appointed manager of the Atlantic Branch metal division of *National Lead Co.*

RAYMOND L. MORELAND of Millcreek, Pa., and HARRY R. CHASE of Oakmont, Pa., have been appointed sales engineers in the Pittsburgh district office of *Hydraulic Press Manufacturing Co.*, Mt. Gilead, Ohio. The company has also appointed ELTON W. TURNER of East Detroit and BRUCE H. LOWE of Battle Creek as sales engineers in its Detroit district office.

OMAR V. GREENE has been appointed general sales manager of *The Carpenter Steel Co.* of Reading, Pa.

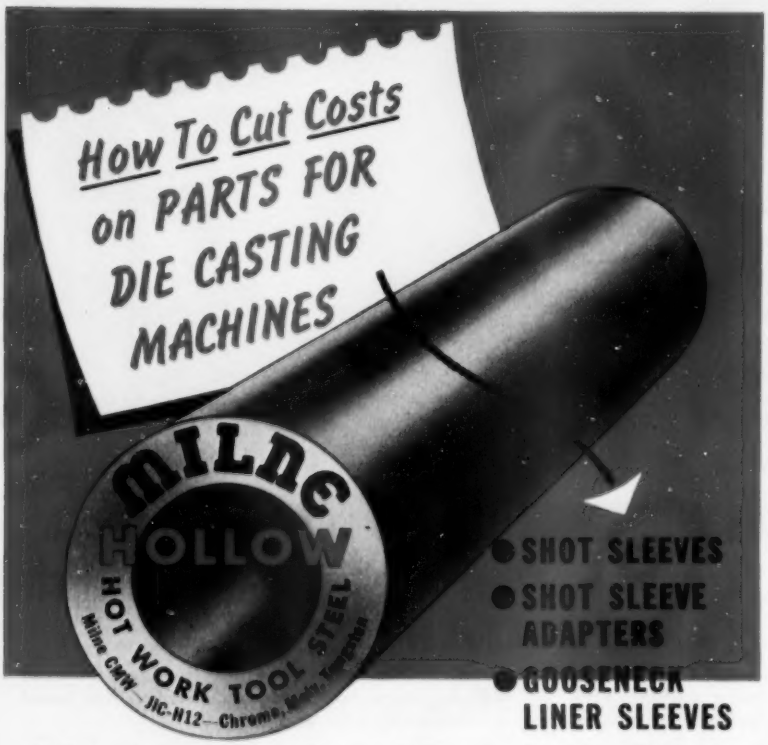
AL LUNDQUIST has been named as sales representative in the Chicago area of *Tamms Industries, Inc.* for their line of raw materials for the paint, varnish and abrasive fields.

Nobur Mfg. Co. of Burbank, Cal. has announced appointment of two manufacturers representatives to handle their line of deburring and chamfering tools: ARTHUR S. DARLING & ASSOC., 14716 Mayfield, Detroit 5, Mich. (for the state of Michigan); and J. J. RICKETSON, 7914 W. 77th St., Overland Park, Kans. (for Kansas, Nebraska, Iowa and Missouri.)

Two sales engineers appointed by *Shell Process, Inc.*, of Chicopee, Mass., are JOHN NEIMAN who will represent the company in Illinois, Indiana, Michigan and Wisconsin, and H. W. KELLOGG in Ohio, Pennsylvania and New Jersey.

With Shell Process Inc.

John Nieman H. W. Kellogg

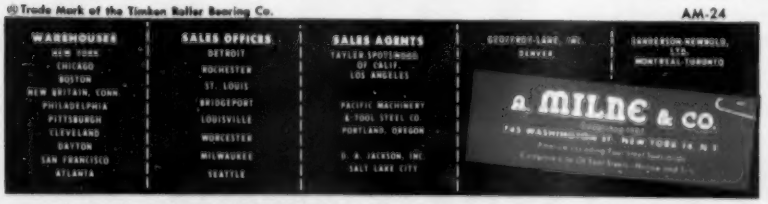

How To Cut Costs on PARTS FOR DIE CASTING MACHINES
MILNE
HOLLOW
HOT WORK TOOL STEEL
Milne CHW — JIC-H12 — Chrome, Moly, Tungsten
● SHOT SLEEVES
● SHOT SLEEVE ADAPTERS
● GOOSENECK LINER SLEEVES

- Hollow form minimizes machining. Cuts waste.
- Cost-conscious die casters are using it today.
- High Strength – Tough – High Red Hardness.
- Sizes from 16" O.D. x 12" I.D. to 2" O.D. x 1" I.D.
- Prompt deliveries from warehouse stock.
- Cut to any length.
- Free from decarb... Rough turned O.D., smooth bored I.D. and saw cut faces.
- Every bar furnace annealed... no scale.
- Full length spray painted with permanently identifying color.
- Heat treat card of matching color with each shipment.

Other Milne Tool Steels – both hollow and solid are being successfully used for parts such as trimming dies, cover dies and ejector dies. Also, Graph-Mo® hollow is being used for parts such as hydraulic shot cylinders and hydraulic closing cylinders.

Write today for free literature on Milne's die casting specialty steels. Address request direct to New York Office.

® Trade Mark of the Timken Roller Bearing Co. AM-24



Be sure to see the new Milne exhibit, Booth 429 A.S.T.E. Show — Phila. April 26-30

For additional information Circle No. 64 on the Reader Service Card

the seven grades of die slick

Here is brief information on the seven different grades of Die Slick—more detailed information will be sent on request.

3 — *Aids parting and ejection on difficult ALUMINUM and MAGNESIUM castings. Non-staining. Enables better metal flow and fill-out of castings.*

4 — *Expressly for BRASS castings—sometimes used on aluminum and magnesium. Extra heavy-duty compound with lubricating graphite. Retains lubricity under high heat.*

9 — *For clean "hardware" finish ZINC castings, where finest plating results are required. Assures maintenance of clean cavities, cores, ejector pins, and guide pins.*

11 — *General purpose compound for ZINC castings. Generally stain-free unless applied too heavily. Prevents sticking and scoring.*

SG — *Standard grade compound for general use on ALL alloys except brass. A high viscosity amber fluid that is not readily burned off by the heat of the dies.*

PS — *Plunger-Slick is an adherent viscous compound that will not melt under highest casting temperatures. Expressly for cold chamber machines, it prevents scoring, sticking, or wear on plunger parts. No. 21—(silver) for average use on all alloys. No. 34—(black) has added micronized graphite for extra high lubricity.*

Specify the grade you wish to try—and the alloy on which you will use it. If you're not fully satisfied, simply return the unpaid invoice.

Cordially,

V. W. Smith

V. W. Smith

..and this is miss Zsa-Zsa; in charge of our die lubricant department!

Even if there were enough journeyman witches to go around, it's a good bet that their die lubricants would be no more reliable than any of the other "home-brewed" concoctions used by some die casters.

Die Slick works *all the time.* Standardized in seven grades to fit specific requirements, Die Slick reduces smoke, sticking, scoring, soldering, ejector pin breakage, rejects resulting from poor surface finish. It is cheaper than witches—a fact proved by more than 80% of all die casters!

Save your witch's brew for a moon-lit night, and try a week's supply of Die Slick at our risk. Simply choose the grade you want to try from the adjacent column, and if you're not satisfied—well, we've got a whole broom-closet full of used witches!

DIE SLICK

used by die casters everywhere

G. W. SMITH & SONS, INC. 5403 Kemp Road, Dayton 3, Ohio

For additional information Circle No. 90 on the Reader Service Card

Reference Data offered in this month's advertisements

2. DRY FILM DIE LUBES — their use for die casting and other types of dies are fully described in Bulletin No. 426-D from Acheson Colloids Co.

6. THE MERCAST PROCESS; what it is and how it can save money on the fabrication of intricate parts is contained in Bulletin No. 706 prepared by Alloy Precision Casting Co.

16. COPPER POWDER and copper base alloy powders, their properties, specifications and uses are described in data sheets available from The American Metal Co., Ltd.

17. PISTON RINGS for die casting machines—a complete catalog of types and sizes can be secured from Auto-Diesel Piston Ring Co.

21. ENGINEERING DATA, applications, and design suggestions are contained in bulletins on powdered metal parts and bearings available from Bound Brook Oil-Less Bearing Co.

24. ALLOYS FOR INVESTMENT CASTING, both standard and specials, are described and their as-cast properties given in a brochure from Cannon-Muskegon.

32. NON-FLAMMABLE hydraulic fluids for die casting machines are described in a brochure from Union Carbon & Carbide Corp. on UCON Hydrolubes.

34. ADVANCED POWDER METALLURGY, published by Dixon Sintaloy, Inc. gives design and application data and a description of the plant facilities available.

35. SMALL DIE CASTINGS — the advantages of the die casting process for making small parts in large quantities — are given in a booklet from the Dollin Corp.

39. SINTERING FURNACES, fuel or electric fired are described in literature available from The Electric Furnace Co.

42. SMALLNESS UNLIMITED, a booklet from Gries Reproducer Co., describes their facilities and gives typical applications of small zinc die castings.

44. THE HENNING MESSENGER, official house organ of Henning Bros. & Smith, gives current news of interest to die casters and foundrymen.

46. DIE CASTING FILE folder is available from the Hoover Co., giving design and application data on die castings.

49. ENGINEERS' HANDBOOK, a fact filled book on design of powder metallurgy parts is available from International Powder Metallurgy Co.

51. ZINC DIE CASTINGS are described in a booklet available from Jersey Plastic & Die Casting Co.

55. FOR INCREASED PRODUCTION on die casting machines, control the oil temperature. Bulletin 1.1 K5 from Kewanee-Ross Corp. describes heat exchangers to do this job.

56. ROCKING ELECTRIC FURNACES for metal melting are described and illustrated in bulletins available from Detroit Electric Furnace Div., Kuhlman Electric Co.

To get copies of any item listed here, simply circle the appropriate number on the Reader Service Card bound into this issue.

57. THE ADVANCED DESIGN and outstanding features of Kux Die Casting machines are described in a catalog.

60. DESIGN INFORMATION and literature about the company's facilities are available from Litemetal Dicast, Inc.

62. MATERIALS HANDLING systems for hot and/or abrasive production in the die casting plant are described in Bulletin MF-530 from May-Fran Engineering, Inc.

64. SPECIALTY STEELS for die casting die work are described in literature available from A. Milne & Co.

67. SAVE POROUS CASTINGS through the use of a sealant. The Metallizing Co. of America has a booklet describing their sealant and the equipment for sealing castings.

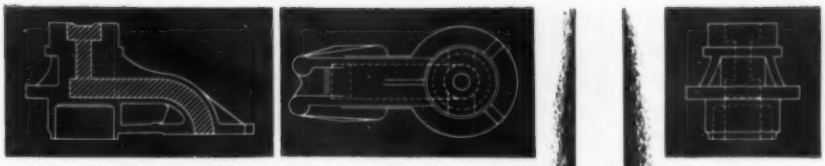
73. DETAILED ENGINEERING INFORMATION on the application of powder metallurgy, and a listing of standard stock bearings can be secured from National Molded Products, Inc.

84. DIE CASTING MACHINES built in England by Projectile and Engineering Co., Ltd. are described in literature from the company.

86. DIE CASTING applications and the facilities of the Racine Die Casting Co. are included in a brochure.

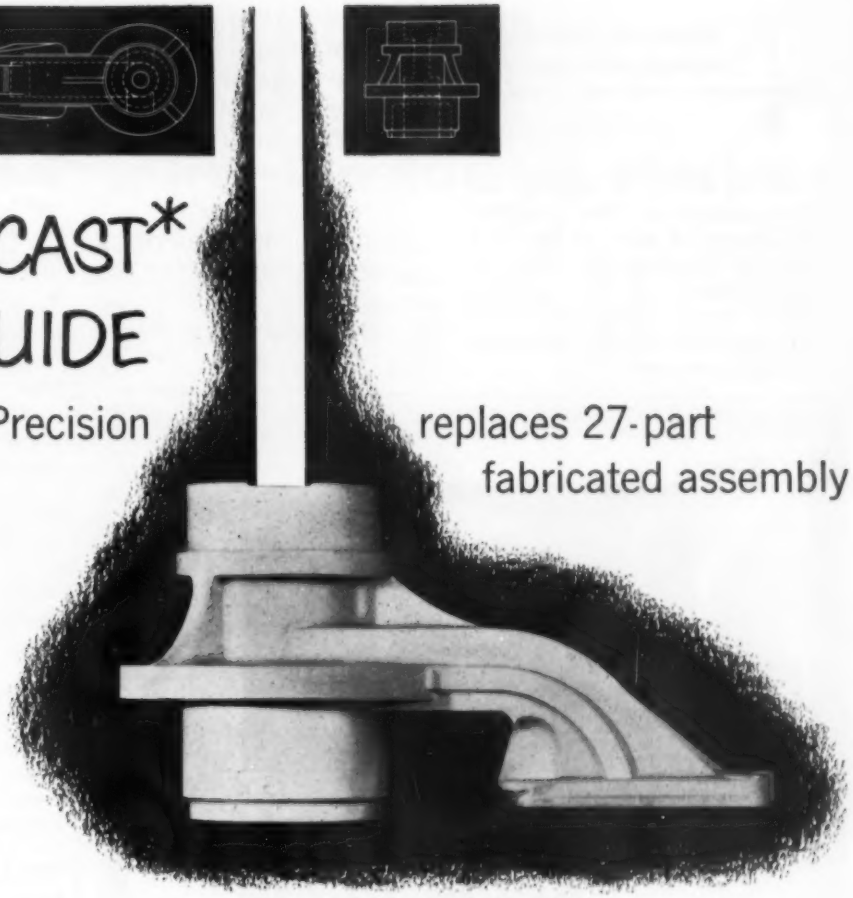
88. INVESTMENT CASTING, a 12-page booklet giving complete facts and figures on the process, has been published by Alexander Saunders & Co.

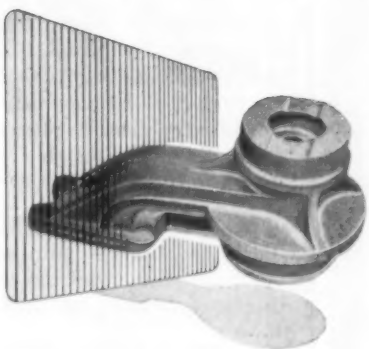
continued on page 121



ONE MERCAST* WAVEGUIDE

by Alloy Precision replaces 27-part fabricated assembly





3D SLIDE FILM IN FULL COLOR shows how this part was made . . . follows it through complete mercasting process from die to finished part. Write and arrange to have it shown to your designers, engineers, planning and production executives. And request your free copy of Bulletin 706 on mercasting.

Original design of this complicated wave guide called for a fabricated assembly of approximately 27 separate parts. Production operations involved machining to extreme tolerances . . . costly precision jigging . . . brazing . . . tedious silver soldering . . . difficult inspection with an extremely high percentage of rejects.

Seeking an improved manufacturing technique, engineers of a major airborne electronic equipment producer decided mercasting might be the answer. They called Alloy Precision application engineers for consultation. Now this part is mercast—by Alloy Precision—as a single unit in 356-T6 alloy to a tolerance of ±.003 inch/inch. Result is that assembly and most machining operations are eliminated . . . production is up . . . rejects are down . . . costs have plummeted.

Perhaps this typical cost-slashing case history will suggest how mercastings—by Alloy Precision—will whip *your* production and inspection problems. Send us prints of your problem parts. Learn how Alloy Precision can save your time, temper and money. A-5149

*Frozen Mercury Investment Casting

ALLOY PRECISION castings company

Dept. H-6
East 45th & Hamilton • Cleveland 14, Ohio

For additional information Circle No. 6 on the Reader Service Card

PERSONNEL CHANGES
continued from page 14

ALAN A. HUTCHINGS has been appointed vice president in charge of sales of the *F. J. Stokes Machine Co.* The announcement of the appointment comes from *FRANCIS* DOUGHERTY, JR. president of the company.

GARY STEVEN, expert on high-temperature metallurgy, has been appointed senior metallurgist at *Armour Research Foundation of Illinois Institute of Technology.*

ARTHUR H. KIRKPATRICK has been promoted to the newly created position of special project engineer at *Frederic B. Stevens, Inc.*

ELMER F. KING has been appointed as metal finishing sales representative in the New England area for *Frederic B. Stevens, Inc.*

CHARLES A. ZANISON has been appointed sales engineer in shell molding for *Mechancal Handling Systems, Inc.*

S. M. BLUMENREICH formerly of the U. S. Dept. of Commerce in economic and statistical work has joined the staff of the *Reynolds Metals Co.* as economist in the sales department.

JAMES R. IRELAND has been named assistant director of research and JAMES G. RICHMOND assistant manager of manufacturing at *The Indiana Steel Products Co.*

JOHN J. BRESS has joined the product development department of the chemical division of *Celanese Corp. of America* as technical service engineer.

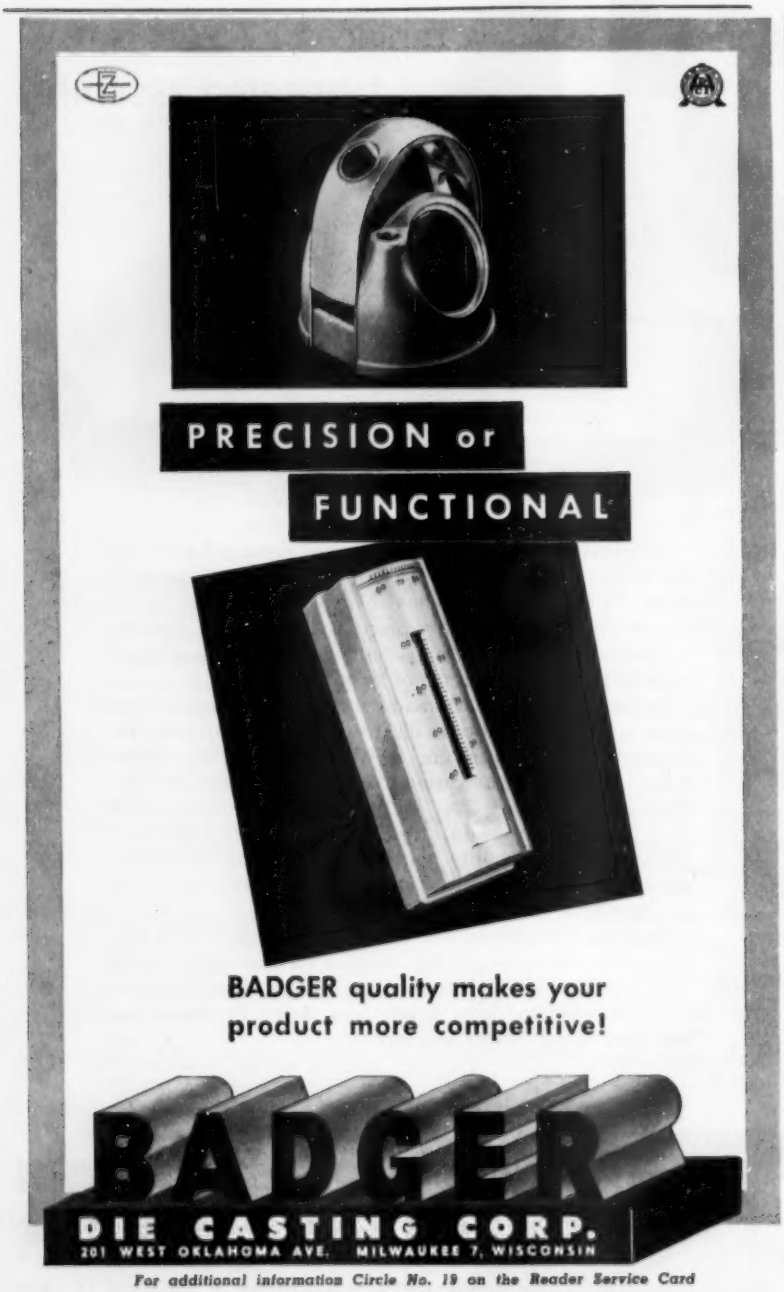
WILLIAM S. KATHER has been appionted supervisor — water-repellent silicone sales development, and MILTON C. LAUENSTEIN was appointed supervisor — rubber fabricating industry sales development by the *General Electric Co.* silicone products department.

COLONEL LESLIE S. FLETCHER has been appointed director of the research fund, *American Society of Tool Engineers.*

ORVILLE H. SCHEEL has been named sales engineer of the *Hydro-Blast Corp.* according to ROBERT K. STRONG, president.

R. E. MCNEILL, JR. president of The Hanover Bank, has been elected a director of *American Smelting and Refining Co.*

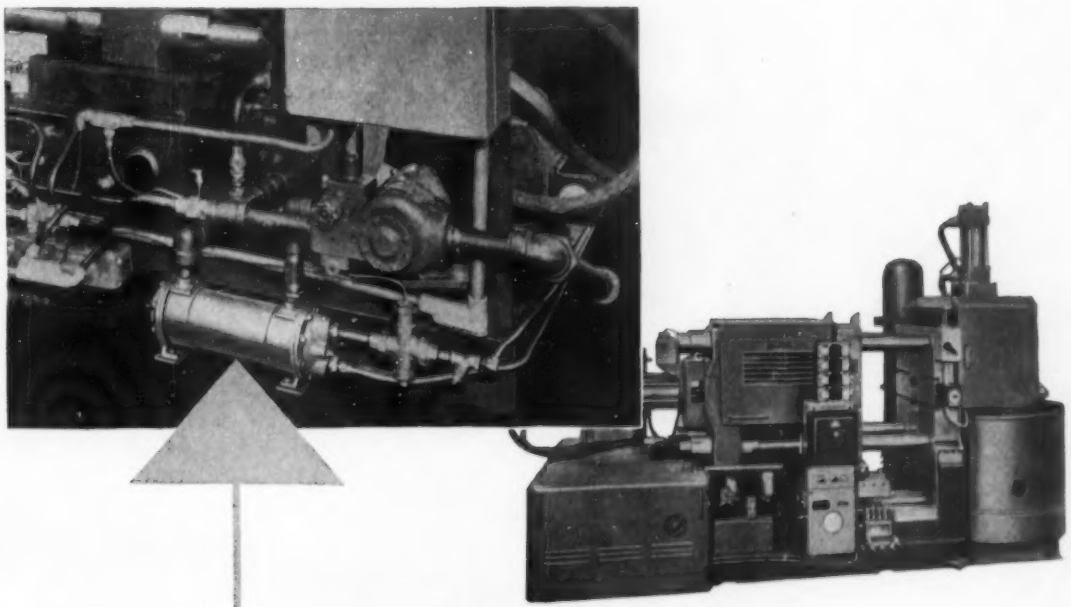
ROBERT A. ZIESING has been appointed chief field metallurgist of *Charles Dreifus Co., Bill-Ettes Div.*



For additional information Circle No. 19 on the Reader Service Card

STANDARD EQUIPMENT

on this Reed-Prentice Die Casting Machine



a ROSS EXCHANGER for cooling hydraulic oil

Producing zinc castings weighing up to 10½ lbs., this Reed-Prentice No. 1½ Die Casting Machine has been designed to apply a locking pressure of 250 tons.

To insure total 34.6 gpm pump capacity at 1000 psi, by preventing slippage from overheated, thinned, hydraulic oil, a Ross Type BCF Exchanger has been installed. *Dependable cooling is assured!*

"Over the years, we have found that Ross Exchangers live up to the high standards we set for our die casting machines . . . they provide trouble-free operation in long service," states Reed-Prentice Corporation.

Testifying to the high thermal efficiency and extreme ruggedness of Ross Exchangers are numerous other leading manufacturers of many types of hydraulic machinery. They, too, have found these pre-engineered, fully standardized all-copper and copper alloy units unsurpassed in meeting their requirements readily.

For detailed information, request Bulletin 1.1K5.

KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

1446 WEST AVENUE • BUFFALO 13, N. Y.

In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

For additional information Circle No. 55 on the Reader Service Card

MAY-FRAN HINGED-STEEL BELT IS DESIGNED TO HANDLE HOT, HEAVY AND ABRASIVE PRODUCTION DIE CASTINGS

Keep parts moving! MAY-FRAN hinged-steel belting is built to withstand excessive punishment from hot, heavy or abrasive parts. Hinged-steel belt conveyors are designed for maintenance-free high production throughout the life of the machine served.

Precision formed from heavy gauge steel, MAY-FRAN hinged links are assembled by means of high carbon steel rods . . . side chains become an integral part of belt. Outside links incorporate interlocking wings which remain positively engaged at all times and keep parts on belt.

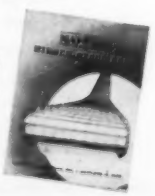
Component parts of MAY-FRAN hinged-steel belting are stocked in a wide range of sizes. Complete steel belting can be economically assembled in minimum time to fit your present conveyor system or meet specific applications. Ranging in width from 6-inches to 6-feet, belting can be furnished in any length or carrying capacity with solid or perforated links.

Speed up production . . . reduce maintenance costs in your materials handling system . . . specify MAY-FRAN hinged-steel belting.

1738-A-MF

MAY-FRAN
ENGINEERING, INC.

Write today for Bulletin MF-530 for detailed information.



DESIGNERS AND BUILDERS OF COMPLETE HANDLING SYSTEMS

1686 CLARKSTONE ROAD • CLEVELAND 12, OHIO

For additional information Circle No. 82 on the Reader Service Card

A CASE FOR *UPF** Bell & Howell Model 253 ...Monterey Projector

A few months ago, Bell & Howell investigated Monarch's *Unified Production Formula.* Today, UPF* provides them with undivided responsibility in the production of their new all-aluminum projector case. Jointly engineered for the most practical die-casting methods—fully machined ... ready for their painting and assembly—multiple handling is eliminated, schedules easily maintained, highest quality standards obtained—all at controlled costs.

You can quickly know how Monarch's UPF* can profitably serve you. Write today to have your Monarch representative discuss your casting requirements.

MONARCH ALUMINUM MFG. COMPANY

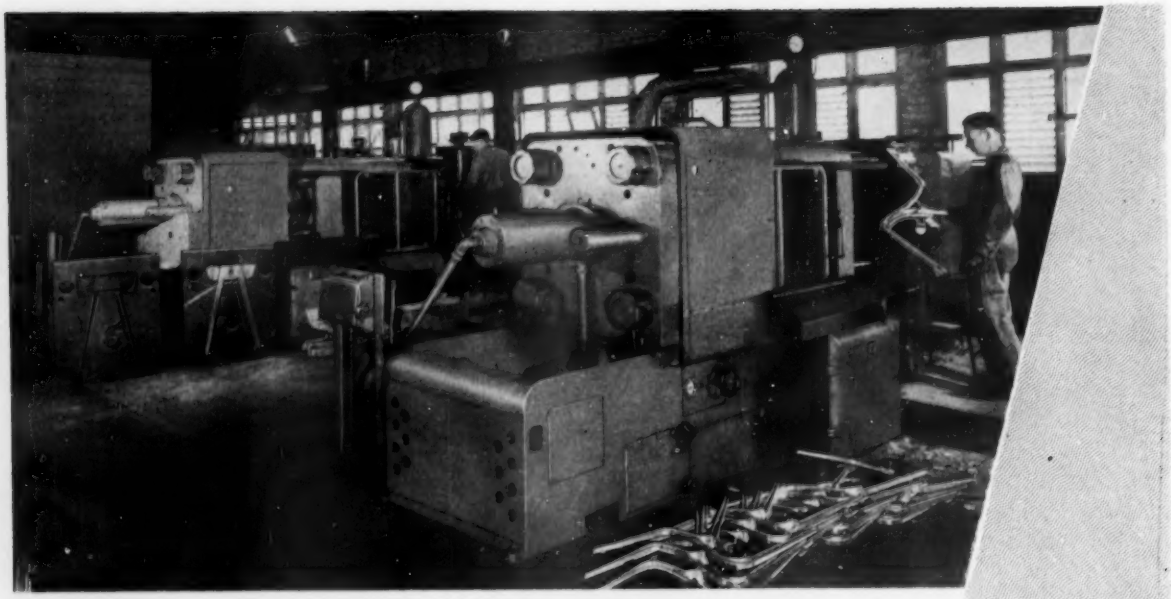
DETROIT AVENUE AT WEST 93rd STREET
CLEVELAND 2, OHIO

***Monarch's Unified Production Formula** gives you undivided responsibility from drawing board to finished casting or assembly.

Better End Products at Lower End Cost

ALUMINUM Permanent Mold Castings • ZINC Die Castings • ALUMINUM Die Castings • MACHINING • FINISHING • ASSEMBLY

For additional information Circle No. 71 on the Reader Service Card



It may seem like kids' stuff to you -

but it requires a high standard of precision die-casting to produce this aluminium furniture

PECO

DIE-CASTING MACHINES

The boys and girls are very much a concern of the State to-day—and notably is this shown in school equipment. Desks and seats are not the cumbrous articles of earlier, Spartan days. Made of aluminum, they're light, bright, strong, comfortable—distributed in thousands by the Educational Supply Association at Stevenage, who utilise Peco Die-Casting Machines in their production. These PECO machines have modernised the technique of cold chamber pressure Die-Casting. They have as a unique feature electrical control covering every movement of the cycle. The four core-pulling connections, hydraulic ejection cylinder and bumper bars for mechanical ejection are fully interlocked, permitting operation in any sequence, and, by use of the hydraulic ejector as a core-puller, the effective die-opening can be increased by as much as six inches.

Illustrated literature will be gladly sent on request

PECO PRODUCTS

THE PROJECTILE & ENGINEERING COMPANY LTD.

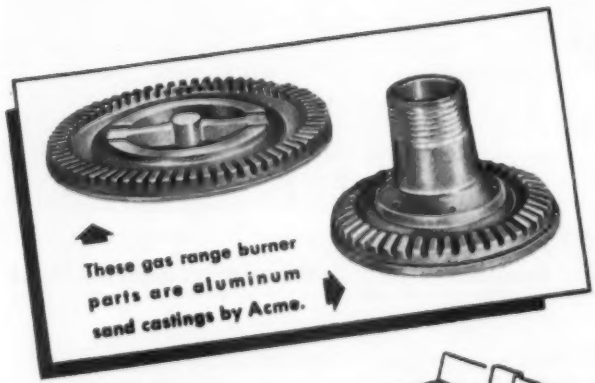
ACRE STREET, BATTERSEA, LONDON, S.W.8
ENGLAND

Telegrams: "Profectus, Claproad, London" Cables: Profectus London

For additional information Circle No. 84 on the Reader Service Card

ACME ALUMINUM & MAGNESIUM CASTINGS FOR APPLIANCES

● An aluminum grill casting produced for a modern range. Acme also produces grill castings with the heating elements cast in as a complete unit.

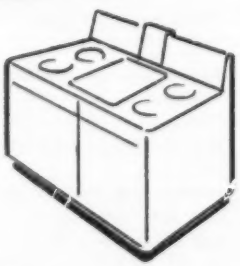


These gas range burner parts are aluminum sand castings by Acme.

● Acme of Chicago offers a *complete engineering service* with over 33 years of engineering and foundry experience back of this service.

● Acme of Chicago also offers a *complete casting service*. Whether your requirements are for ten or hundreds of thousands of castings of a single design — for light metal castings weighing a few ounces or hundreds of pounds — or for aluminum and magnesium heat treated and aged castings to meet military specifications — we are interested in working with you.

Your inquiries and requests for information are always welcome



PHONE
PROSPECT 6-5035

ACME ALUMINUM FOUNDRY CO.

6841 SOUTH BELL AVENUE • CHICAGO 36, ILLINOIS

For additional information Circle No. 4 on the Reader Service Card

MORE PIG AND INGOT AVAILABLE!

Kaiser Aluminum again increases supply for foundries and independent fabricators!

Additional supplies of Kaiser Aluminum pig and specification ingot are now available *for prompt shipment!*

These new supplies—made possible by our expanded production capacity—represent another of our consistent increases in the amount of pig and ingot offered to foundries and independent fabricators.

Contact any Kaiser Aluminum office in principal cities or Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California.

HERE'S WHY INDEPENDENT FABRICATORS RELY ON KAISER ALUMINUM!

Faster service and delivery on orders from our conveniently located plants at Newark, Ohio; Chalmette, Louisiana; Halethorpe, Maryland; Mead and Tacoma, Washington.

Dependable source of supply because we are an integrated producer.

Outstanding engineering service, including design assistance and other technical advice.

Our ability to produce to all standard specifications or to all special customer specifications.

Kaiser Aluminum

The Nation's Largest Supplier of Aluminum Pig, Ingot, and Billet

For additional information Circle No. 54 on the Reader Service Card

24 HOURS OF "BACK TALK"

...but none about these die-cast parts

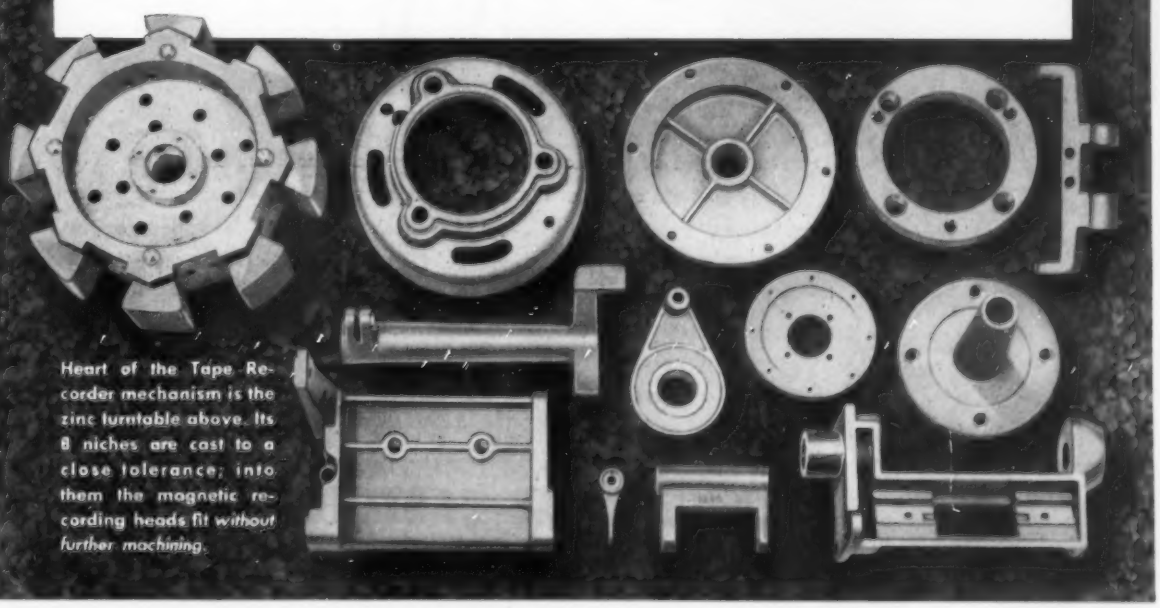
CASE HISTORIES FROM MT. VERNON FILES

Soundscriber's new 24-hour Magnetic Tape Recorder and Reproducer is the first in its field to provide such a long period of continuous, unattended recording in so small an instrument. It weighs but 80 pounds.

One important reason why this precision instrument is so light, so thoroughly practical, yet so moderate in cost, is the die cast aluminum and zinc parts you see here.

States Soundscriber Corporation: "From long experience with our standard line of dictating equipment, we have found die casting a lower-cost way of making intricate parts. Further, this method allows for more economical use of light-weight metals. Mt. Vernon die casting has always met our high quality standards."

Whatever *your* product, simple or intricate, it will pay you to consult with us. We have up-to-the-minute facilities for precision die casting of aluminum and zinc, and a vast reservoir of experience. It's quite possible that we can show you the way to greatly increased production, lower unit costs —improved products, too.



Heart of the Tape Recorder mechanism is the zinc turntable above. Its 8 niches are cast to a close tolerance; into them the magnetic recording heads fit *without further machining.*

SCHULTZ

Specialists in Zinc Die Casting

Here are two of the many reasons why major manufacturers rely on us for quality zinc die castings. We are thoroughly equipped with the most modern equipment available. Production techniques have been developed for fast, efficient and economical operations. Our tool and die shops represent the best equipped in the country. Finally, our staff of skilled specialists is always ready to assist you with your specific requirements.

Nearing a Quarter of a Century of Service—Exclusively Zinc Die Castings

SCHULTZ DIE CASTING COMPANY

1810 CLINTON STREET • TOLEDO 7, OHIO

For additional information Circle No. 89 on the Reader Service Card

Between the Lines of this and future issues

Heavier Duty for Die Castings . . .

Structural die castings have come into widespread use as the properties of these castings have become better known, and experience has proved them to be dependable in many critical applications. An impressive structural use of magnesium die castings is the hub for an aircraft landing wheel gear. Read about it beginning on page 33.

Special Properties and Special Purposes . . .

One of the advantages of working with metal powders lies in the variety of **special** properties that can be obtained. Many could not be equalled by any other manufacturing process. Reviews of some of these are offered in this issue: Friction — Page 37; High density — Page 40; Self-lubrication — Page 49; Infiltration of a skeleton of one metal with the liquid phase of another metal — Page 57.

More Than One Way to Skin a Casting . . .

Every thousandth of extra metal you can pare off a raw casting, the greater will be the saving in secondary costs. PMM concentrates on showing ways of achieving closeness in dimension, knowing that no one process is the answer to all problems, but among the six precision processes we report will be the answers to some of your toughest design problems. Many designers now use two or more PMM processes to save money and eliminate difficult machining. Two articles this month show how the PMM processes complement each other . . . On pages 34-36 a report on railway signal equipment, and on pages 44-45, military signal equipment.

New Development in Shell Mold Casting . . .

Briefly covered is a new method for fastening shell mold halves together, starting this month on page 99. Small, U-shaped spring steel clips are speeding one phase of this new casting method.

Looking Ahead . . .

Among the many articles scheduled for the next several months are reports on stainless steel powders, die casting melting practice, die castings in the TV industry, high strength iron powder parts, automatic finishing of portable tool die castings, and case histories on varied products including microtomes, storage batteries, garden equipment, appliances, cameras, etc.

For Your Ferrous Casting Needs Get These . . .

4 Freedoms

Freedom from . . .

1 Porosity
2 High Cost Material
3 Expensive Machining
4 Metallurgical Variation

with

PERMANENT MOLD Gray Iron Castings

Permanent Mold Gray Iron Castings by DOSTAL offer many advantages. Their structure is uniform and surface scale is eliminated. These 2 factors permit higher speed machining with faster feeds. The dimensional accuracy and uniformity of DOSTAL Permanent Mold Castings reduces machining operations to a minimum. Permanent molded castings are uniform in hardness and their structure is dense and porous-free.

Write Us Now — Find out how you can cut the costs of your products through the use of Permanent Mold Gray Iron Castings.

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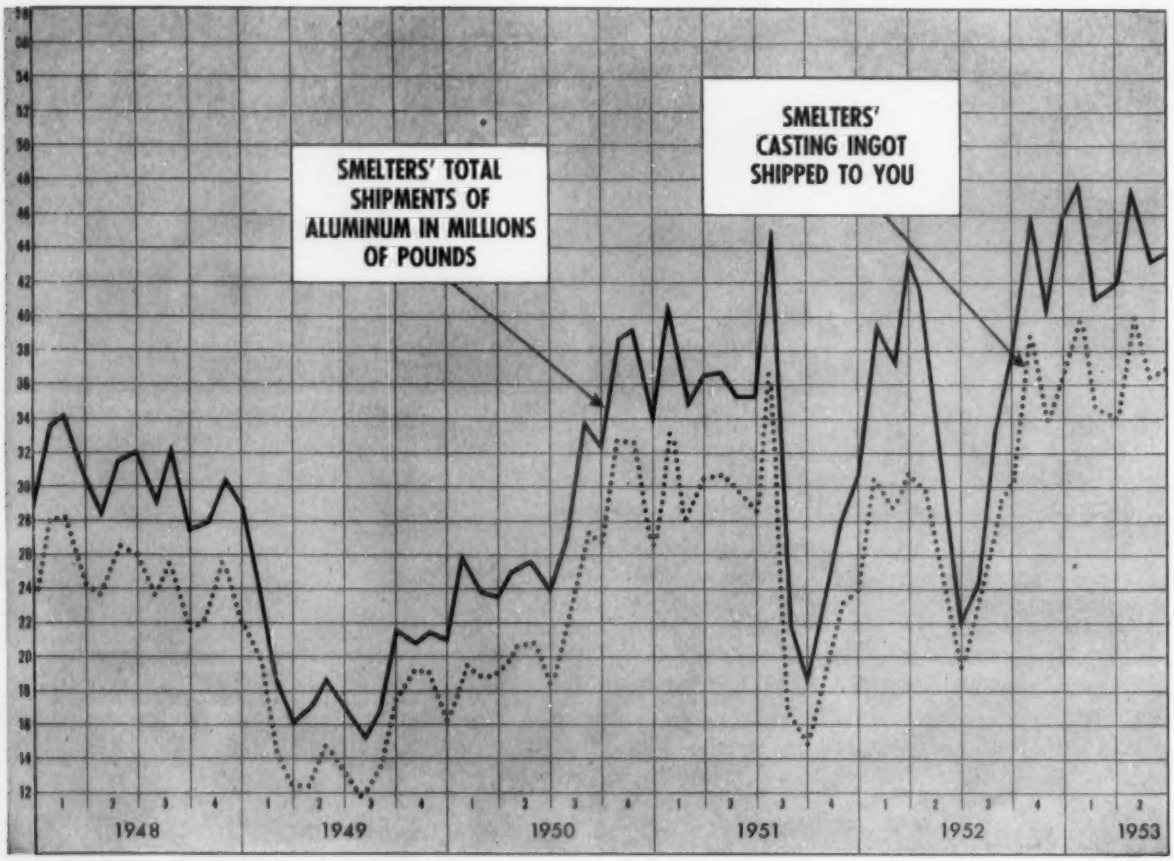

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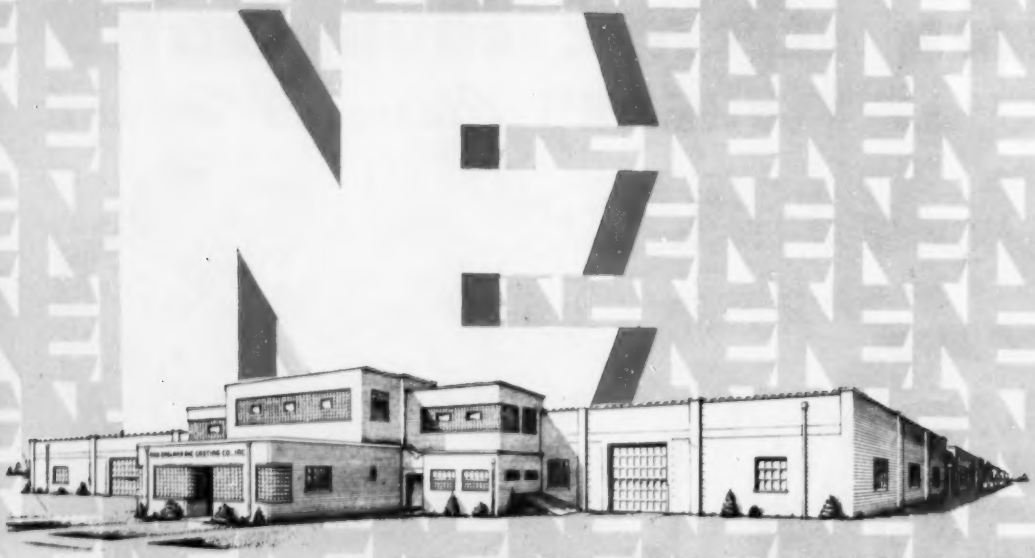

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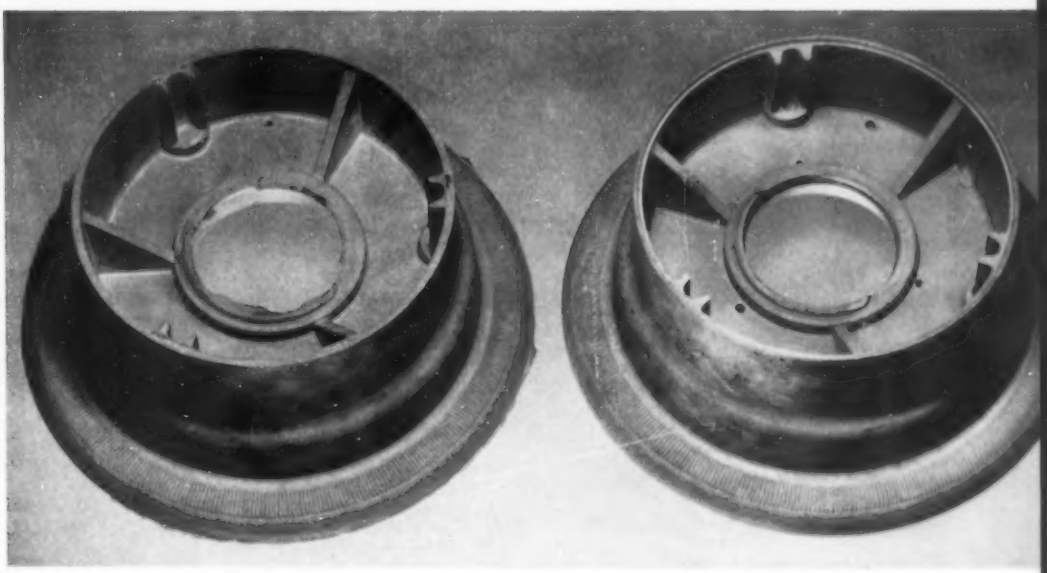


BY ELMER VAN SICKLE, President
Cleveland Aircraft Products Co.

AIRCRAFT landing gear wheels require high impact strength and light weight as the two principle design considerations. Both of these requirements can be secured, particularly for small commercial craft, in either aluminum or magnesium die castings.

Initial production of such wheels by Cleveland Aircraft Products Co. was as green sand castings. These castings required a very considerable amount of machining, some of which was difficult and expensive. Because of the limitations of the casting process, the best design, from a weight standpoint, could not be used. Sections were heavy and some surfaces quite rough since the cost of the wheels would not permit over-all machining.

To cut costs and to give a lighter weight wheel that was adequately strong, the manufacturing method was changed to an alumnum die casting. With this change it became possible to incorporate strengthening webs and bosses so that section thickness could be reduced and yet retain sufficient rigidity and impact strength for the service requirements.

The inherent accuracy of the die casting process automatically eliminated most of the machining on the wheels and gave a sufficiently good surface so that it could be used as cast.

Such items as the knurling to prevent slippage of the tire could not be sand cast adequately, but could be done by die casting. Small cored holes and holes at odd angles had to be drilled in the sand casting and are now cored in the casting.

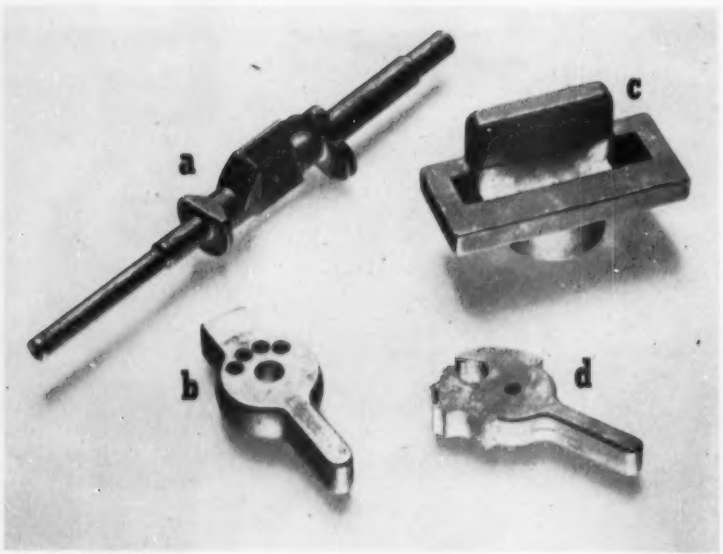
Casting defects, which accounted for a large number of rejects, were eliminated when the shift to die casting was made. The problem of casting defects is particularly expensive when, as in this case, a considerable amount of machining time is spent on each piece. When a defect is found early in the machining, there is little loss since most foundries

continued on page 133

Difficult or Impossible to Machine?

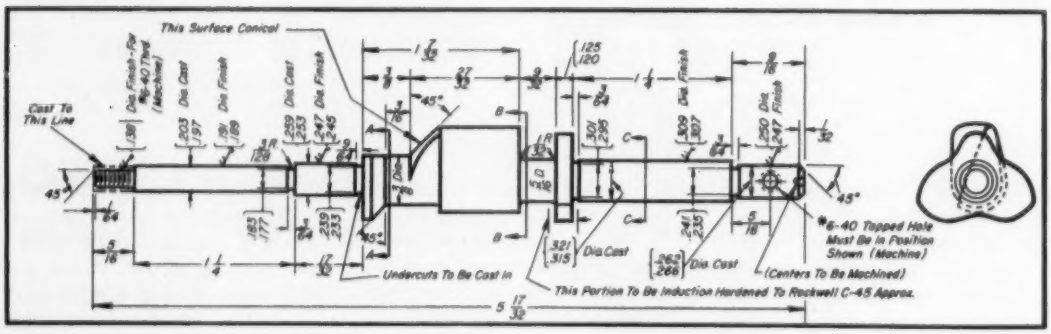
These pieces are in routine production as investment castings . . .

BY J. W. LOGAN, Mechanical Engineer
Railway Signal Eng. Dept., Union Switch & Signal Co.



1. FOUR investment cast components of railway signal equipment are typical of the difficult shapes and contours produced by this method.

2. DETAIL drawing gives better idea of the difficult shape and close dimensions of the switch rod shown in Figure 1a.


This Surface Conical
Cast To This Line
Undercuts To Be Cast In
This Portion To Be Induction Hardened To Rockwell C-45 Approx.
*6-40 Tapped Hole Must Be In Position Shown (Machine)
(Centers To Be Machined)
Dia Cast
Dia Finish
45°

TODAY'S engineer must do more than merely design a product that will fit the job at hand. He must gaze into a crystal ball and come up with a piece of equipment that is sufficiently flexible to meet the exigencies of tomorrow.

One of the best words coined to describe this sort of design is "imagineering". Yet designing a product to meet as many of the possible future needs as can be visualized often results in a part that defies economical manufacture. That is, it would defy economical manufacture if it were not for the Precision Metal Molding processes. These processes, capable of producing a finished or nearly finished product with an unbelievably complex contour, will fabricate almost any known metal or alloy.

The switch rod shown in Figure 1a is a piece that is economically possible only because of the investment casting process. While it is perfectly true that this part could be made either as a single unit, laboriously carved from bar stock, or as an assembly of many separate parts, the costs involved would preclude its use.

As an investment casting, however, if the die sinker can make a mold, the foundry can cast the piece. Not only can the foundry cast the piece, but they will do it with sufficient accuracy so that little, if any, secondary machine work needs to be done and with surfaces that are sufficiently smooth to use in the as-cast condition are as lightly buffed after casting.

Look at the drawing, Figure 2; in five places tolerances must be held closer than can be cast and require machining, but the machine work is of the simplest type, either turning or OD grinding. Every other dimension and every contour on this piece is held by the foundry to the required accuracy, generally a total allowable variation of 0.006.

In general, roundness about the axis is good, but because the part is long and thin, it may warp a slight amount. When such warpage does occur a simple straightening job corrects the trouble.

Cast in 1050 steel by International Nickel Co. the switch rod, after machining, has the detent induction hardened to 45 Rockwell C.

The mating switch parts shown in Figure 1b. and c are two more investment castings that, while simple in contour, presented a considerable manufacturing problem by any process other than investment casting.

The lever "b" could, of course, be made by contour machining or by blanking and then shaving and machining. For any such method, the initial tooling costs would be high and tool maintenance costs exorbitant. As an investment casting, however, International Nickel Co. produces this piece and the mating housing Figure 1c in 1017 steel easily and economically.

As finishing operations only boring and threading are required, relatively low cost operations. Both parts are case carburized and hardened to 50 Rockwell C. Final finish is chromium plating on the exposed surfaces.

Finally in this group of switch parts is the lever shown in Figure 1d. As is the case with the previous switch lever, high initial tooling and tool maintenance costs precluded any manufacturing operation except investment casting.

This lever is cast by the Hitchiner Mfg. Co., Inc. in 1015 steel and is delivered to the user fully machined and ready for case carburizing. As in the case of the two other switch parts a case depth of from 0.008 to 0.010 is secured and the part then hardened to 50 Rockwell C.

In order to operate generators, speedometers and similar equipment; one or more of the journals of railway cars and locomotives are fitted with a standard internally splined coupling. Manufacturers of devices that are to be driven from this journal coupling use a standard, or nearly standard splined head which fits into the coupling.

For their small generators, Union Switch & Signal Co. uses this connection. Because there is always the possibility of misalignment in mounting the splined head and coupling must act as a universal joint. The splines on the coupling are, however, straight. This requires that the head have a spherical curvature on both the face and on the edges of the splines. Such a head is shown in Figure 3.

This head is being investment cast in 1045 steel by Hitchiner Mfg. Co., Inc. and is fully machined and hardened to about 50 Rockwell C before delivery by the manufacturer.

3. COSTS have been cut 55 percent by changing from machined bar stock to investment casting.

Just how much secondary machining is done is not known, but probably the counterbore is cleaned up, the bore reamed to remove any possible taper, and the key-way broached.

This part is one of those on which rather dramatic savings have been possible by changing the method of manufacture. Formerly made by machining from bar stock, the cost has been cut 55 percent by investment casting.

DIE CAST parts are also finding increasing usage in this safety equipment, replacing gray iron castings to gain lower costs and lighter weight. For the story, turn to the next page.

DIE CASTINGS

In Railway Equipment Zinc Die Castings Replace Gray Iron

BY W. B. WELLS, DC Electrical Engineer,
Railway Signal Eng. Dept., Union Switch & Signal Div., of Westinghouse Air Brake Co.

ONE of the problems that designers of railway signals have had to contend with is the phantom light resulting from reflections of incident light on the lamp lens. Under conditions of fairly strong incident light, this reflection may be sufficiently bright to give the appearance of a lighted signal.

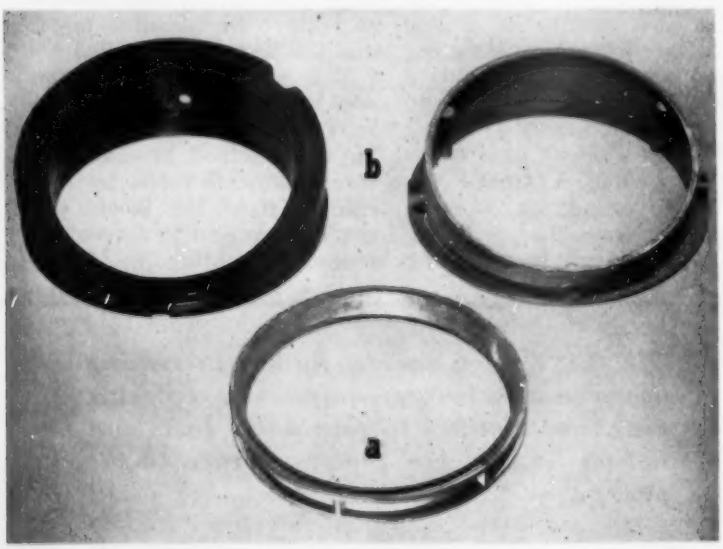
To solve this problem, the engineers of Union Switch & Signal, Division of Westinghouse Air Brake Co. have developed a so-called "Phankill" device. The "Phankill" consists of a metal honeycomb, painted black, that is mounted in front of the outer lens. All light rays more than eight degrees above the horizon either strike the honeycomb before entering the signal and are absorbed, or the returning reflection is absorbed by the honeycomb so that there is no reflected light of high intensity to give a phantom signal.

Two of the parts of the "Phankill" device are now zinc die castings replacing iron sand castings. The "Phankill" ring shown at "a" below, supports the honeycomb mentioned above. As formerly made, the iron sand casting weighed 3¾ lbs. as received from the foundry. Over-all machining, except the O. D. was necessary to ready this piece for use.

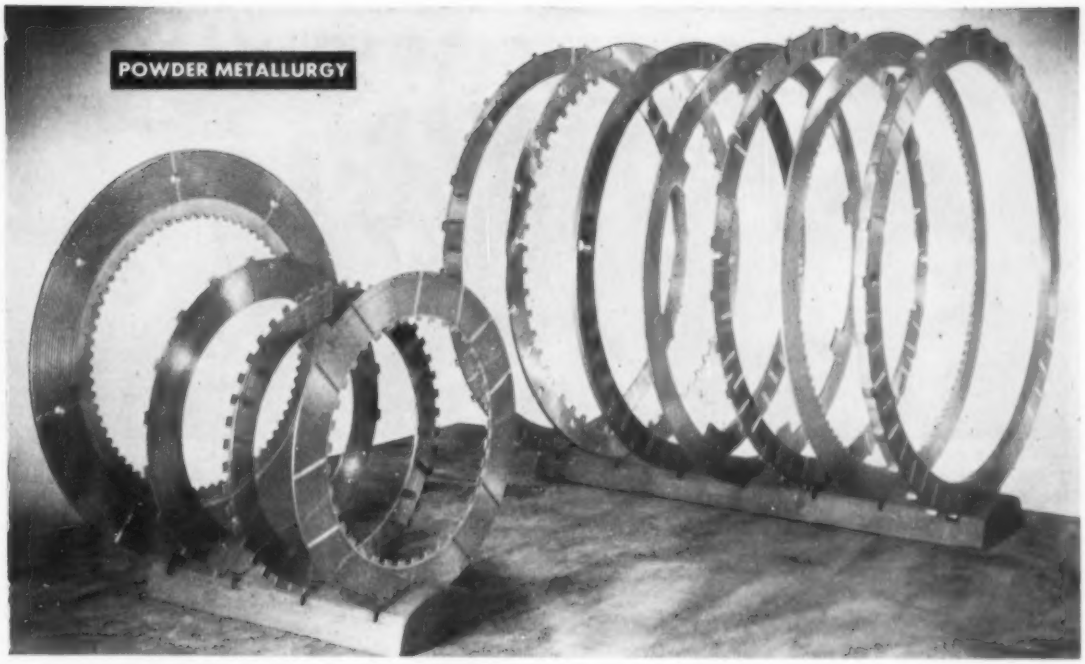
Conversion to zinc die casting resulted in a piece weighing only 1-2/3 lbs. and on which the only machine work required is to drill three small holes in the circumference. This large reduction in machining costs has resulted in a ring costing only 13 percent the cost of the cast iron one.

Another part of the "Phankill" device that has been converted from a sand casting in iron to a zinc die casting is the lens ring shown at "b" below. As in the case of the phankill ring, important savings in machining costs were made by the conversion.

In addition, the weight of the part, as delivered, was reduced from 9 lbs. to 2-1/3 lbs. Costs were reduced to less than one half and because of the flexibility of the die casting process a better designed lens-ring is now possible.



REDUCED MACHINING accounts for most of the savings gained when these railway signal components were redesigned as die castings.



Seven different types of metal powder discs are used in each of these tank cross drive units. Metal powder and steel opposing discs are shown.

Metal Powders For Brake and Clutch Work Surfaces

Accurate control of friction properties is one useful attribute of powdered metal components.

BY L. P. KANE, Engineer
S. K. Wellman Co.

WITHIN the last 25 years, the use of metal powders in friction devices has gradually grown and become increasingly widespread. In early 1931, Samuel K. Wellman pioneered in the development of this product, undertaking an intensive program of trial and error development work which within the next four years resulted in the basic manufacturing techniques used today.

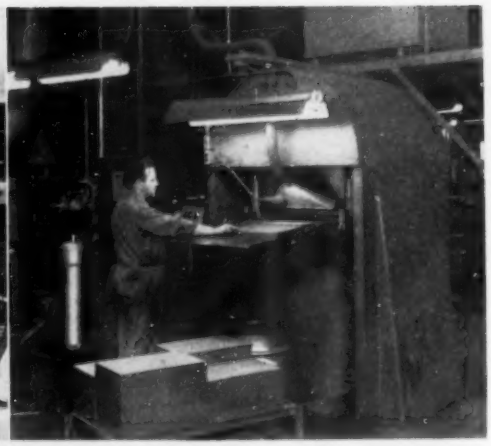
Metal powder friction materials originally gained recognition in the aircraft landing brake field. The materials in use were becoming unequal to the task as speed and weight of planes increased causing the need for a better friction surface to step up efficiency ratio.

Results of experiments with powder metallurgy were highly satisfactory. Better performance, less fading, longer life, softer and more uniform braking were gained through the use of this product.

The greatest single property contributing to the acceptance of metal powder friction elements is their great wear resistance. Principally, the ability to absorb a greater portion

continued next page

TWO DYNAMOMETERS in the foreground of the S. K. Wellman Company dynamometer room, above, are used for testing "wet" clutches.



AUTOMATIC BRIQUETTING press, right, is capable of 3000 tons and handles an area of 230 sq. in. Thickness of compacts varies from 1/16" to 1".

Metal Powder Brake and Clutch Work Surfaces -- cont.

of the heat of the application adds to their long wearing qualities, in addition to offering better life for the opposing surfaces by precluding distortion, heat checking, and scoring because the energy is dissipated in two directions more quickly from the contact surfaces.

The natural capability of metals to withstand higher surface temperatures than organic materials before melting or disintegrating contributes greatly to the faculty of the friction devices to absorb energy at higher rates and therefore, can be used at higher temperatures and at greater pressures and speeds.

Due to the greater stability of ingredients making up the product, a more constant coefficient of friction is had through temperature and pressure variations than accompanies most other types of friction materials. This is especially important in the design of slip clutches such as tension control and overload clutches.

To meet the industry's diversified operating conditions and demand for quantitative friction properties, test facilities are continually being expanded. Complex dynamometers with instrumentation to record stopping time, velocity, pressure, and temperature are compiling useful data for future applications and improvement of present installations.

Dynamometer testing is based upon the use of various friction clutches or brakes to decelerate or bring to a full stop, a flywheel rotating at speeds determined by the value of energy absorption desired. By this means, energy levels as high as 2,000,000 foot pounds and rotating speeds as high as 3600 rpm have been achieved.

Measurement of stopping torque or stopping time permits direct calculation of coefficient of friction developed by the friction facings. Tests are conducted both dry and oil lubricated to simulate field conditions. In some instances, the entire brake or clutch assembly is tested. In other tests such as automotive transmissions, only the clutch part of the mechanism is used.

Dynamometer tesing is used to control quality of production friction elements as well as development of new materials. In many cases these tests are supplemented by actual field performance tests.

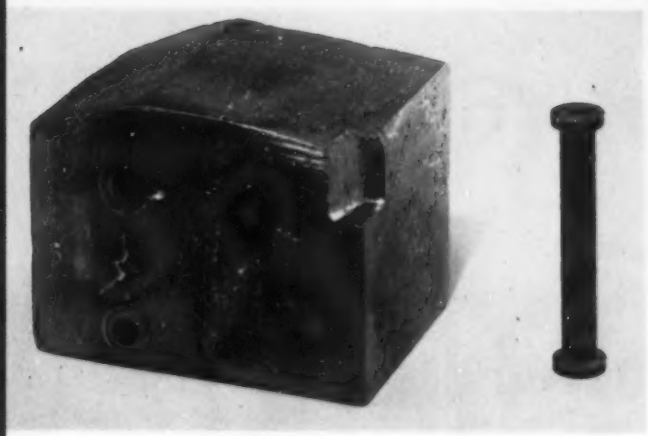
To satisfy the current trend to oil cooled clutches and brakes, emphasis has been placed on test and development of materials operating in an oil bath. Following are several typical "wet" clutch dynamometer arrangements:

Continuous Drag Test — clutch is engaged at a constant speed of 3600 rpm and is allowed to slip or drag for 12 seconds, followed by an 18 second interval with clutch disengaged. Throughout the test, the torque output is held constant by regulating the applied pressure to compensate for changes in coefficient of friction. During the test, which consists of 240 cycles, disc and oil temperatures are measured. After completion the friction elements are measured for wear and studied for surface condition and distortions.

Inertia Type Test — An inertia flywheel is brought to a speed of 3600 rpm, the drive

continued on page 123

Weight and Dimension Closely Controlled in Lead Counterweight



THE problem of casting a counter weight that meets specific shape and size requirements and also weight requirements is generally solved by making the part of an adequately heavy material of the required shape and size and then drilling holes in some non-critical portion to remove enough weight to bring the part within requirements.

When this can be done it serves as an inexpensive method of getting a relatively great mass concentrated in a small volume.

In the case, however, where there is no non-critical portion the weight must be adjusted in some other manner. In the case of the lead counter weight for aircraft application shown above this condition existed.

Since the center of mass of this weight had to be precisely located and metal removal would shift this point, the usual method of adjusting weight could not be used.

A further complication arose due to the steel inserts. These inserts of aircraft quality steel, had to be precisely located with respect to each other and in relationship to the outer surfaces. Tolerance requirements allowed a center-to-center distance variation of only ±0.004. Further the four inserts had to be parallel to each other and set at right angles to the upper and lower surfaces.

Solution to this fabricating problem was found in a permanent mold casting made by Gasket, Packing & Specialty Co., Inc. of New York.

Two-Piece Casting Solves Dimensional Problem

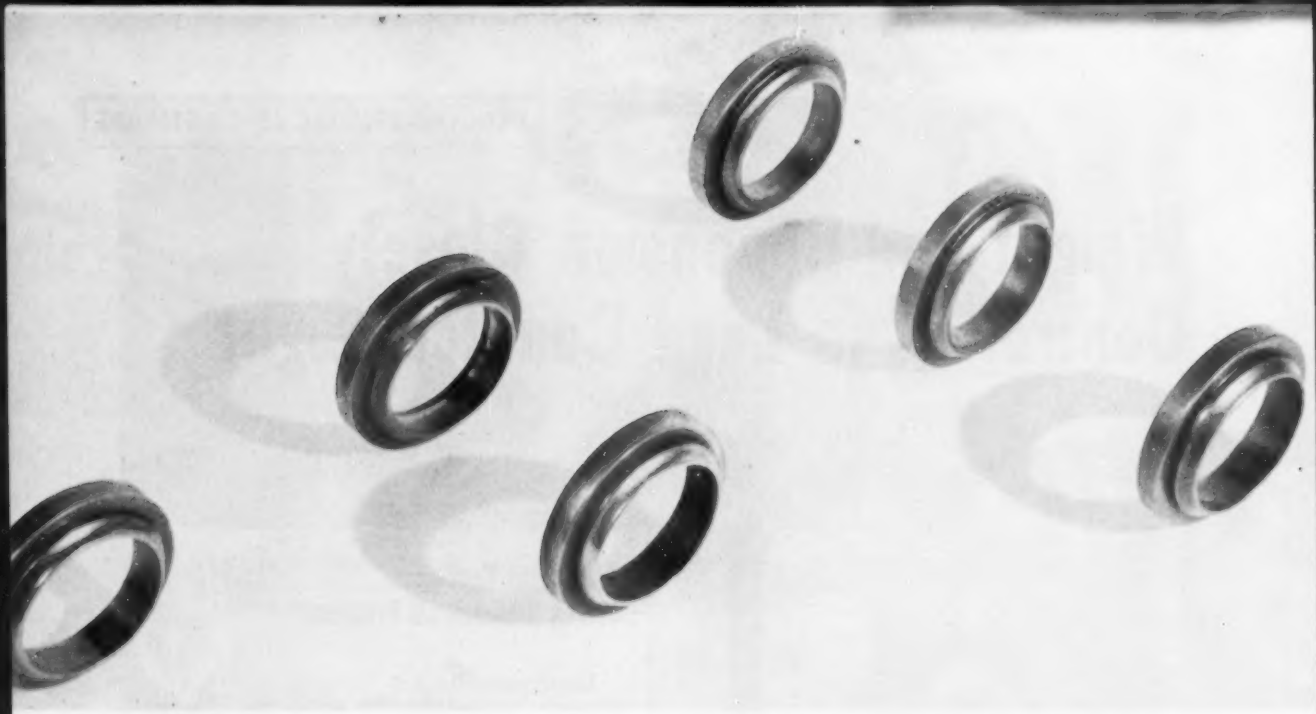
Dimensionally the problem did not seem difficult since pins to hold the inserts in place could be easily put into the mold and the proper alignment and positioning achieved. However, when the first several castings were made, it was found that unequal shrinkage occurred so that the inserts were displaced and out of alignment.

The problem of shrinkage was solved by casting the piece in two parts. One piece was first cast containing two of the inserts. After cooling, this piece was placed in another mold and the balance of the weight cast against it. Since the mass of metal cooling from the liquid to the solid was much less with this technique, it was possible to control shrinkage to give an acceptable casting.

New Alloy Choice Solves Weight Problem

There remained, however, the problem of weight. The finished casting weighs 14.36 pounds and had to be held to a total weight variation of 0.12 pounds. In order to secure the correct initial weight, the lead was alloyed with antimony. Up to 8 percent decrease in weight can be secured by adding up to 16 percent (the maximum amount that will stay in solid solution) of antimony. The use of a steel mold and the casting technique noted above enabled the foundry to hold the required weight tolerance.

Thus by a combination of modified casting technique and alloying, it was possible to make this weight to the specifications required without requiring secondary machining to correct either weight or dimensional accuracy.



High Propertied Powdered Iron Parts For Motorcycles and Bicycles

AMONG the factories which, in Sweden, deal with powder metallurgy Husqvarna Vapenfabriks Aktiebolag occupies a special position. It is a leading factory in the mechanical industry and has since 1944 carried out important pioneer work in the production of electrolytic iron powder and high density structural parts.

The company was founded in 1698 and can look back on a tradition, for the production of high quality products. Three works, one of which includes one of the largest foundries in the north of Europe, are owned by Husqvarna.

The main products of the company are sewing machines, hunting rifles, shotguns, bicycles and light motor cycles, ovens and stoves, washing machines and other household articles.

Its products are exported all over the world and are known for their quality and precision. Many of them are also well-known in the United States, e. g. the Viking sewing machines and the Husqvarna rifles.

Little about the powdered metal components manufactured by this Swedish firm has been published in the literature. Only the British powder metallurgist, W. D. Jones, has mentioned them in one of his publications:

" . . . Husqvarna Vapenfabriks Aktiebolag a company making sewing machines, bicycles, and sport shot guns had developed processes for the manufacture of small parts for them using quite original methods. Starting with electrolytic iron powder which they make themselves — capacity 750 tons in 1951 — by a technique of double pressing and double sintering, they produce components having a dimensional accuracy and surface finish superior, probably, to any product made anywhere else. Tensile strengths of 40,000 lbs. sq. in. with elongations of 32-35 percent are quoted for their unalloyed sintered steels . . . "

Precision Metal Molding magazine is the first American periodical to give more detailed information about some Husqvarna products and their properties, and will show parts used in sewing machines, hunting rifles, shotguns, bicycles and light motor cycles in a number of articles. The present article is the first of several and deals with some bicycle and motorcycle parts.

THE Swedish metallurgical and mechanical industry has played a significant part in the development and application of the powder metallurgical production technique in Europe. Powder metallurgical products, like hard metals, collector brushes, friction linings, sintered bearings and sintered structural parts, are industrially manufactured; the production of sponge iron powder and electrolytic iron powder has become of substantial importance.

In 1944 Husqvarna Vapenfabriks Aktiebolag, decided to enter the field of powder metallurgy and produce sintered parts for its own products. Here the traditional Husqvarna demands for high precision, high physical properties and excellent surface finish were from the very beginning the guiding motives of an extensive research and development work. Such requirements could only be met by producing high density structural parts, and so the company became one of the pioneers in this special field of powder metallurgy.

It soon became obvious that the demand for high precision and high physical properties could not be met with the iron powders then on the market. The use of electrolytic iron powder became mandatory. Husqvarna, therefore, decided on the use of this raw material and developed, in cooperation with leading Swedish electrochemists, a method for producing it.

Husqvarna acquired some pressing and sintering methods originating in Germany and developed them into mass production techniques. In this connection the company also designed its own presses and furnaces. A production technique was achieved, which in several points differs considerably from the methods used elsewhere.

By using its own electrolytic iron powder as a raw material and copper as an alloying component, Husqvarna now produces three distinct qualities of sintered steels, giving different physical properties.

BY DR. GERHARD ZAPF, Manager
Metal Powder Dept., Husqvarna Vapenfabriks Aktiebalog, Husqvarna, Sweden

The first of them has a tensile strength of 37-40,000 psi and an elongation from 32 to 37 percent.

The first of them has a tensile strength of 60,000 psi and an elongation of 12-14 percent.

The third has a tensile strength of 85-88,000 psi and an elongation of 8-12 percent.

A great variety of structural parts is now produced for bicycles, motorcycles, shot guns, rifles, sewing machines, calculating machines, and household articles, the company has — for European conditions — large pressing and sintering shops, equipped with hydraulic and mechanical presses for loads of 4-1500 tons, and furnaces for high temperature sintering at 1200-1500C. (2190-2730F. — ed.)

Sintered Sprocket Wheels for Bicycles

Fig. 1 shows a number of sintered sprocket wheels for bicycles. It may at first seem surprising that such parts could be successfully and competitively be made by powder metallurgy. They were previously produced by blanking and stamping from sheet.

Such parts run under relatively high loads and are submitted to impact loads. They were therefore made from low carbon steel sheet,

continued next page

1. POWDERED IRON bicycle sprockets replace stamped sprockets.

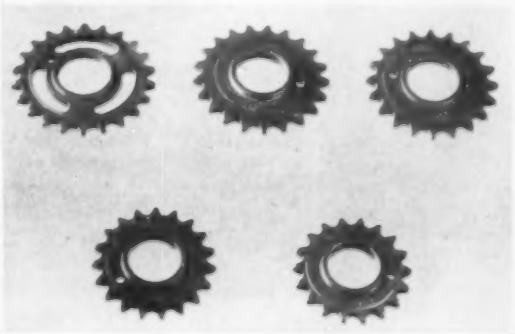
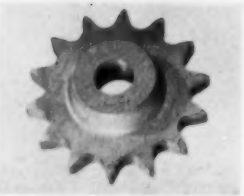


TABLE I

Part	Raw Material, kg/1000 parts		Production Time, minutes/1000 parts	
	conv. mfg.	sintered	conv. mfg.	sintered
Sprocket wheel for bicycles				
18 T	225	96	530	397
19 T	253	116	520	397
20 T	265	122	495	397
21 T	300	140	970	397
22 T	320	120	970	515

TABLE II

Part	Raw Material, kg/1000 parts		Production Time, minutes/1000 parts	
	conv. mfg.	sintered	conv. mfg.	sintered
Sprocket wheel for motorcycles	275	140	3920	1350



2. IN PLACE OF a dropforged sprocket, this powdered iron sprocket for a motorcycle gives superior physical properties.

cyanided and hardened. The sintered steel has proved very successful under those working conditions. Every tooth withstands under a steady rupture test, an axial breaking load of 350 kg (7700 lbs., ed.) and a tangential load of 850 kg. (18,700 lbs., ed.)

The strength of the threads is checked in a special fixture, onto which the wheel is screwed in the same manner as under working conditions and then stressed by means of a chain. The threads withstand a force of at least 850 kg. (18,700 lbs., ed.) before they fail. In nearly all tests, the chains fail before the threads. In addition to their excellent physical properties, the sintered sprockets, which of course are carburized and hardened, have a better wear resistance than hardened stampings. Road tests showed a 20-30 percent lower wear than with sprockets made from low carbon steel stampings.

To what extent the sintering can compete with the conventionally manufactured sprocket is shown in Table 1. The raw material consumption and the manufacturing time for both production methods are indicated, clearly showing the advantage of the powder metallurgical method of production.

Husqvarna now produces ten different types of sprocket wheels, which are not only applied in its own cycles, but also in a great many other cycles of European production.

3. SCREW MACHINE parts have been replaced by powdered iron for the steering bracket cone (top) and lock nut (below) used on bicycles.

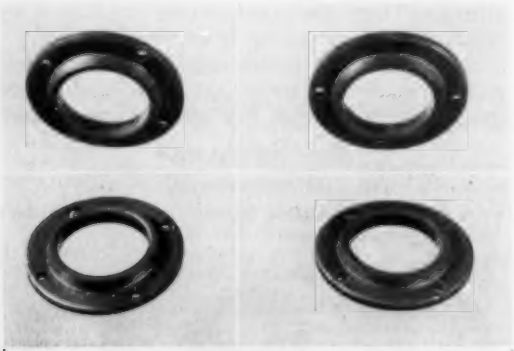
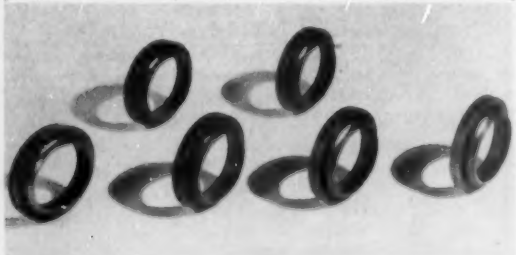


TABLE III

Part	Raw Material, kg/1000 parts		Production Time, minutes/1000 parts	
	conv. mfg.	sintered	conv. mfg.	sintered
Steering bracket cone for bicycles	81	24	830	480
Lock nut for 2-speed gear hub	80	46	1820	335



Motor Cycle Sprockets

Another very interesting example is illustrated in Figure 2, a motorcycle sprocket. This part was previously made as a chromium-nickel steel dropforging, subsequently machined by turning and milling. Now sintered steel is used.

The economical advantage of the latter production method is obvious when comparing the raw material consumption and the manufacturing time for 1000 parts. (Table II). Even in this case the sintered part is carburized and hardened, and a road test showed a 15-25 percent higher wear resistance than the carburized and hardened chromium-nickel steel part.

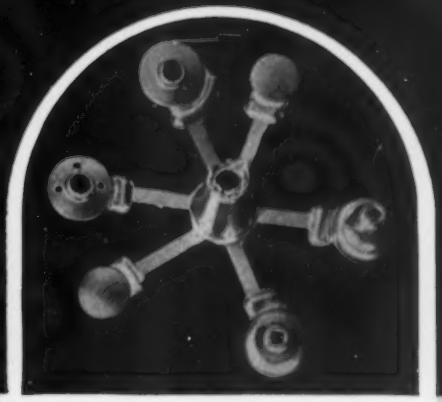
Powder Metallurgy vs Screw Machine

Powder metallurgy competes successfully with screw machines in the production of bicycle parts, as demonstrated in Figure 3, two carburized and hardened parts which were previously made by screw machining.

One of them is a steering bracket cone which serves as ball-bearing race in the steering of a cycle. This part is submitted both to

continued on page 125

telling the story of 'dag' dispersions



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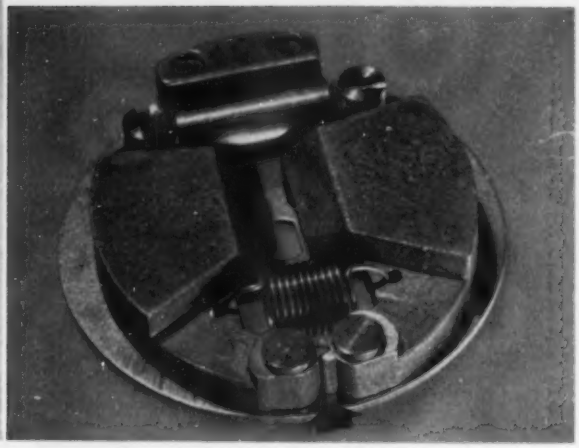


1. This Signal Corps generator has . . . **2.** investment cast governor weights . . .

Three Ways to Use PMM Processes

BY W. A. BROADLEY, Chief Development Engineer
National Pneumatic Co., Inc., and Holtzer-Cabot Divisions, Boston, Mass.

FACED with the necessity of designing a new A. C. hand generator for use on U. S. Signal Corps field telephones, the Holtzer-Cabot Telephone Equipment Div. of National Pneumatic Co., Inc. found that the proper application of precision molded metal parts helped to make possible a smaller, lighter weight generator which met or exceeded the specifications set by the Signal Corps.

The generator had to meet electrical specifications and, in addition, pass the rugged drop and water immersion tests. The unit finally developed is shown in Figure 1. The precision molded parts that helped to make possible the successful completion of this problem are die castings, investment castings, and powdered metal parts.

INVESTMENT CASTINGS When the generator is in use, it is essential that no signal be put out until some minimum voltage is achieved. This means until some minimum speed of rotation is reached. To control the output, a throw-over switch is employed which functions on the principle of a fly-ball type of governor. Such a speed control mechanism is shown in Figure 2.

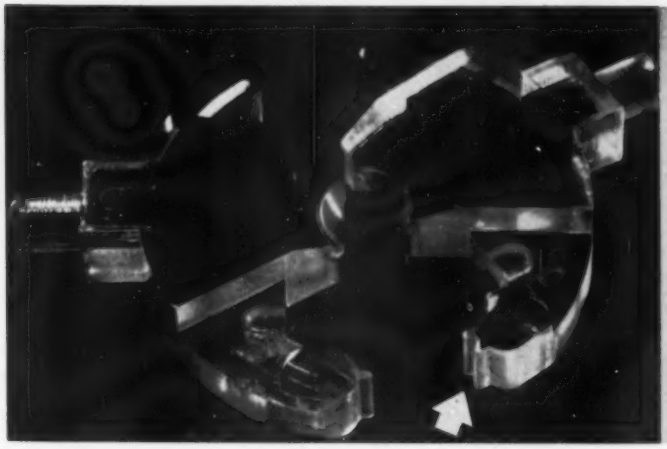
The castings, made by Gray-Syracuse, Inc., are 85-5-5-5 leaded bronze. Functional and special requirements fixed the design rather rigidly so that machining from wrought stock or machining a sand casting would have been prohibitively costly.

As investment cast, however, the only machine work needed is quite inexpensive. Three holes are drilled in each casting, one of which is tapped, the back surface sanded and sometimes a facing cut at the pivot points.

Operating like a fly-ball governor, the switch would open uniformly if the weight of the two castings were exactly equal, the entire rotor balanced and pivot friction the same on both pieces.

Not all of this can be secured and maintained so a toothed interlock between the two weights has been provided. Such an ar-

unit, investment castings, die castings, sinterings are used.



3. from polystyrene patterns, and also . . .

4. die castings with powder metal bearings.

rangement is not particularly new, but the point of interest here is that **these tiny teeth are integrally cast with the weight and need no secondary finishing at all.** Production of these gear teeth with sufficient accuracy to use in the as-cast condition shows the extreme accuracy and good surface finish that is possible by investment casting.

The polystyrene patterns from which the castings are made are shown in Figure 3. Arrows indicate the cast teeth.

A passing item of interest in connection with these castings is that 40 weights are cast per flask.

POWDER METALLURGY Referring again to Figure 2 it is clear that if the rotor carries only the weights and the necessary appurtenances, it will be out of balance. To insure balance and hence smooth operation, a small brass counterweight is added. The part, made by the Keystone Carbon Co., is leaded bronze of about the same composition as the bronze used in the weights. It is furnished with all holes cored ready to be riveted in place as received.

The other powdered metal parts used on the generator are self lubricating bushings made by the U. S. Graphite Co. Two of these bushings are standard spherical types held into their seats by spring washers and staked into place. These bushings provide a moderate amount of self alignment, they are shown installed in two of the castings shown in Figure 4 (see arrows).

Two other bushings are used in the gear case. These are standard flanged bearings in every respect, but the application is unique. The method of installing the two bushings in the casting is shown schematically in Figure 5. The point of note is the space between the two bushings.

Earlier, attention was called to the fact that these generators have to be completely water tight. Where the shaft passes through the outer casting is, of course, a prime point of entry of water. To provide a permanent seal and at the same time avoid possible trouble if, for example an O-ring were used, the annular space between the two bushings is packed with a good grade of fibrous grease. Not only does this provide the required seal, but further serves as a lubricant reservoir.

DIE CASTINGS Five aluminum die castings shown in Figure 4 are used on this generator. All of them are used to reduce the amount of machining that would be required if any other method of manufacture were employed. Because many of the fits and bores must be held to very close tolerances some machining has to be done in any event.

continued on page 124

17 Advantages of die cast pipe fittings:

1. COMPLEX assemblies that in brass or cast iron require welding, brazing, or threaded joints can often be cast as a single part.

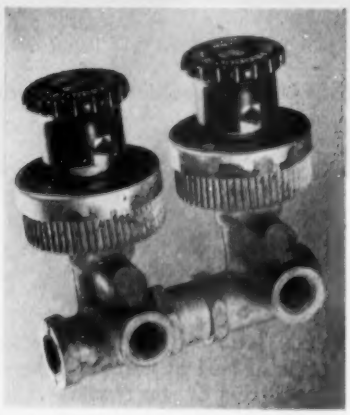
2. HOLES of any size, down to about 1/32 inch can be cored (depth will be limited by the diameter).

3. CORES can be pulled at almost any angle and intersecting cores can be easily provided.

4. BLIND holes are cored as easily as through holes.

5. CORES can be held very precisely as to location, angle, parallelism.

6. EXTERNAL threads can be cast if they can be located properly with respect to the die parting.



1. MANY of the advantages of zinc die castings have been put to use in this oil burner valve body.

7. THREADS up to 24 per inch can be cast; finer threads should be machined.

8. INTERNAL threads can sometimes be cast but it is generally better to core the hole and then tap as a separate operation.

9. WHERE desired, very thin wall sections can be cast with the assurance of uniform wall thickness around a core.

10. WHERE internal pipe threads are to be cut, the taper on the core rod can be set to match the standard taper on pipe threads.

11. SURFACE finishing can be either eliminated or greatly reduced.

12. NEARLY all bosses, pins, etc. for mounting and fastening can be cast integrally with the part.

13. SELF-TAPPING screws can be used in many cases; saving the cost of tapping, speeding assembly, and often with a lower cost per screw than machine screws.

14. KNURLING, accurately shaped hexagons, splining, etc. can be formed in the casting operation so that secondary machining is not needed to form them.

15. THE nature of the die cast metal will often make possible more desirable design than is possible when either brass or cast iron is used.

16. DIE CAST zinc or aluminum has satisfactory corrosion resistance for most normal applications of plumbing or heating fittings, but can be further protected at low cost by any of several chemical surface treatments.

17. NUMERALS, lettering, patent numbers, identification marks, company insignias, etc., can be formed integrally in the surface of die castngs.

Plumbing Fittings By Die Casting

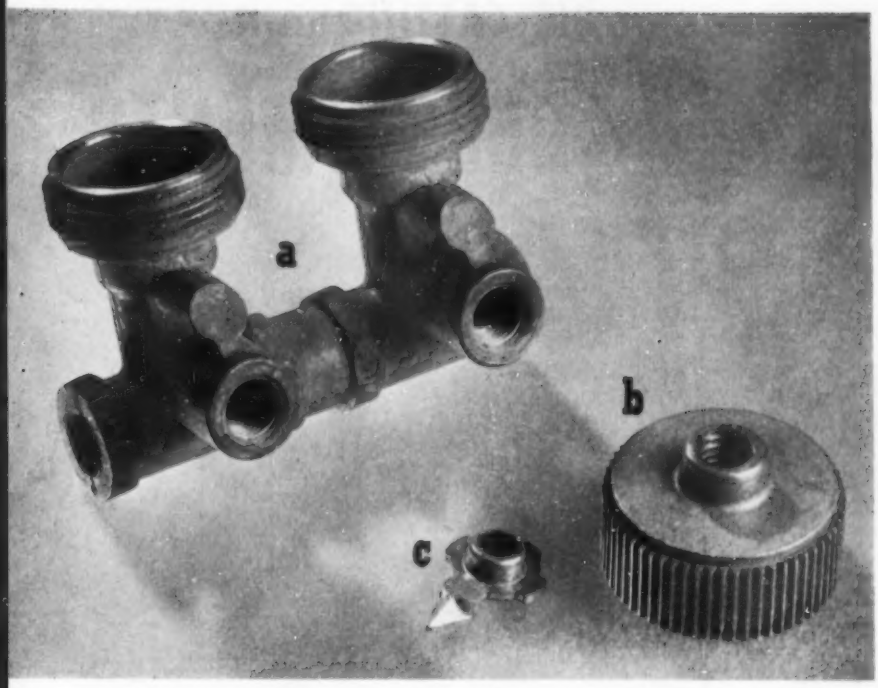
WHERE can die castings be used in the manufacture of plumbing fittings? Broadly, wherever fittings are applied at pressures up to about 250 psi when using zinc die castings and somewhat above that when aluminum die castings are used.

Through the use of die cast fittings, both the manufacturer and the consumer would benefit from lowered costs. A large saving in brass, often in short supply, would result.

Where aluminum die castings are used, the lowered weight means easier handling and less shipping expense.

In the design phase, there are more pronounced advantages. Because both brass and cast iron are the usual materials, the designer must work within the limitations imposed by methods of economical fabrication of these two materials. With die castings, on the other hand, many of these limitations are removed and the engineer is given a much freer scope.

There are, of course, certain limitations which must be recognized. For example, where the fitting may be subjected to a very high torque in assembly or disassembly, die castings should not be used. Likewise, care must be exercised that zinc or aluminum is not used in connection with metals where galvanic corrosion would occur. However, there are many advantages to the use of die cast fittings that today's designer should consider.



2. CAST THREADS, knurling, intersecting holes tapered holes are among features obtained without extra machining costs by virtue of the die casting process.

Before discussing a particular case where a zinc die casting has most successfully replaced brass, look at the tabulaltion above of some of the outstanding advantages of the die casting process in these applications.

It will be well, then, to look at a typical case where a zinc die casting has replaced machined brass for a valve body.

The Lynn Products Co., Inc. of Lynn, Mass. is one of the large manufacturers of oil-fired heating appliances. On multi-burner stoves and heaters using kerosene, distillate or low flash point fuel oil, it is desirable that only one revolution of the adjusting knob carry the oil control valve from fully closed to fully open. A further requirement is that within this one revolution very fine adjustment of flow be permissable.

These two factors mean that the adjusting screw on the stem be a fairly fine thread for delicate adjustment and further, that a needle type of valve cannot be used since a small vertical movement of the needle would not give adequate maximum opening. A flat seat operating with a flat faced plug, is the logical answer.

With all-brass construction, such a flat seat can only be used when the plug is faced with a soft material such as rubber which might disintegrate or soften and swell when in continuous contact with petroleum products.

With brass, only a single valve could be made as a unit; further, machining the brass valves was very expensive and created a large amount of scrap.

By changing to a zinc die casting, Figure 1, not only was the manufacturing cost very sharply reduced, but a far better design became possible.

This casting so well exemplifies most of the advantages enumerated above that a recapitulation with reference to the particular part is advantageous.

1. An assembly of three parts, two valves and a nipple, has been replaced by a single casting.
2. Holes of several different sizes have been cored.
3. Cores at precisely held angles to each other are pulled in three directions.
4. One of the cored holes is blind.
5. The holes are held precisely at right angles to each other.
6. The large diameter thread for the cap is cast with sufficient accuracy so that chasing is not necessary.
9. The wall thickness around the long hole is held precisely uniform and is relatively thin.
10. For those holes (four in this case) where tapping is done later, the taper on the core pin matches the standard taper for pipe threads.
11. The as cast surface is

continued on page 132

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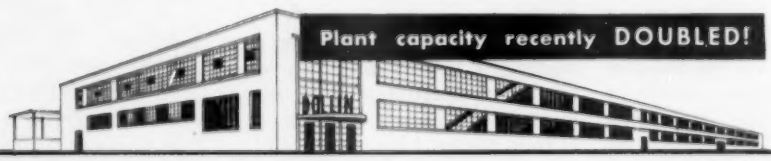

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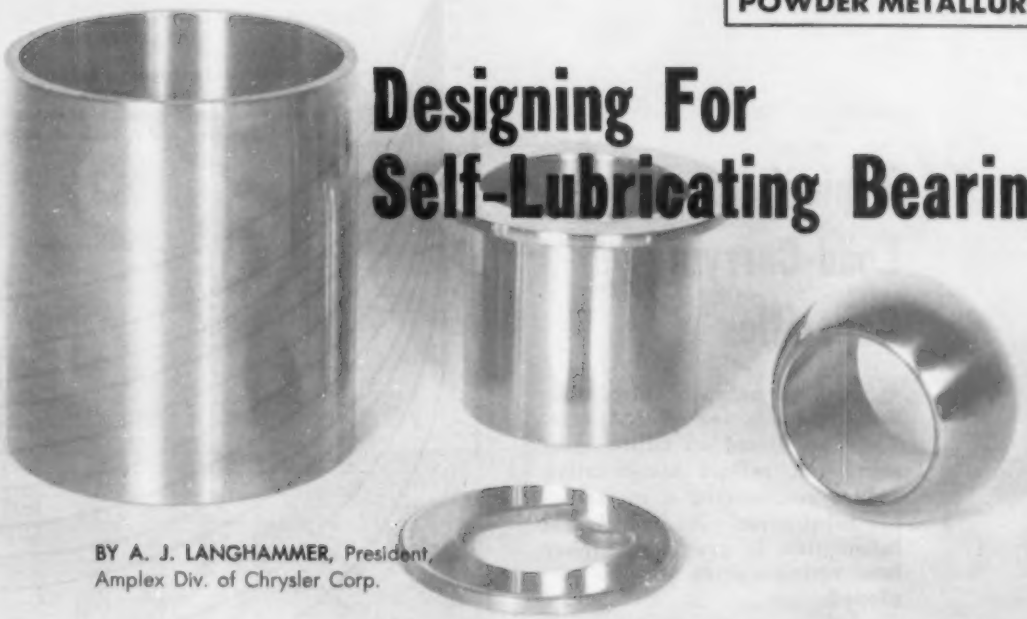
POWDER METALLURGY

Designing For Self-Lubricating Bearings



BY A. J. LANGHAMMER, President,
Amplex Div. of Chrysler Corp.

Consider these thirteen factors when you design for powdered metal bearings

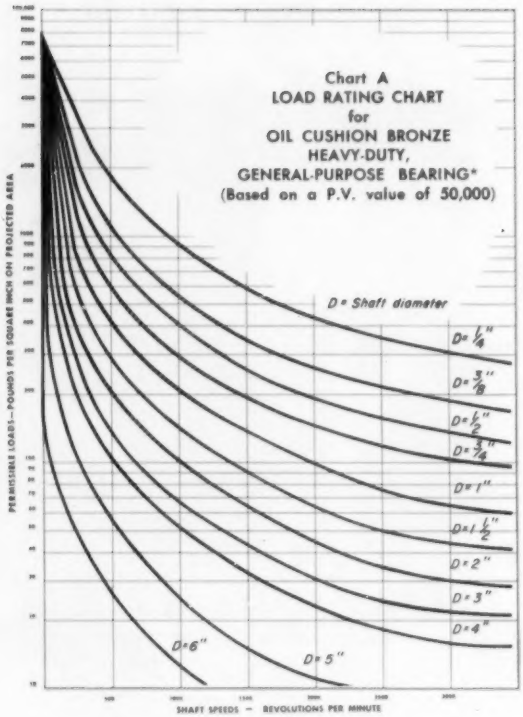
THE theory and practice of leading designing engineers with regard to self-lubricating bearings has altered appreciably during the last decade. His interests are broader, much broader. He now also takes into consideration the viewpoint of the purchasing department, the production department, the master mechanics or tool division, and the bearing field engineer. Primary considerations, however, are the same as that of his predecessor, but more sternly so. Thus, his FIRST requirement is **Trouble-Free Performance and a High Factor of Safety.**

Experienced designers never lose track of these two factors. They understand that the customer of today insists that the bearings in his equipment or apparatus perform satisfactorily though it be neglected, overloaded, or otherwise abused. Moreover, it takes little effort on the part of the engineer or purchasing agent to assure him of the proper quality and performance.

Let me diverge for a moment. At the age of 16 I was in the third year of apprenticeship as a tool maker. When seasonal I generally rowed about 2 hours a day which was coupled with a lot of swimming, no smoking, and, of course, none of the corn liquor or bourbon for which my home state of Kentucky is so famous. At Ludlow, Kentucky, a tri-state rowing championship (skiffs) was held each Labor Day. They had a fleet of 80 boats that looked alike and were made from amateur molds. I entered the contest, chose a fast skiff, and won the championship. That was an early lesson in quality. Prior to this a retired steamboat captain had taken an unusual interest in our activity, and disclosed how you could determine at a glance whether or

Typical Load-Carrying Capacities

***Charts to help in calculating bearing loads are offered here. They are based on Oilite bearings, and reflect conservative values considering a minimum of lubrication. As additional lubrication is provided, higher load rating values may be employed.**



not a skiff was fast. It is easily determined. (No time trials, measured courses, stop watches, etc.). You merely put the empty skiff into the water and observe the "setting of the stern." If the stern sets high out of the water it is a "pickle boat." Likewise the same terminology applies if the stern is submerged in the water. The fast skiff has the stern about 1¼" above the waterline. Then when the oarsman takes his seat, the stern just about touches the water or is slightly below the water line. Obviously, such a skiff will "plane" in rowing. The "pickle" boats exercise a severe drag and greatly penalize the oarsman.

Bearings, like skiffs look very much alike. Fortunately, however, just as in the case of a skiff, a quality bearing can be easily identified. Just squeeze two different makes of bearings endwise in a vise and observe whether strength and ductility is manifested. Another method which also takes but little time, but requires greater skill, is to lay these bearings flat on the anvil of a vise and tap with a hammer, observing deformation and breaking point. A micro-photograph, too, is highly informative. Obviously experience and long-time tests are not necessary to identfy a quality bearing.

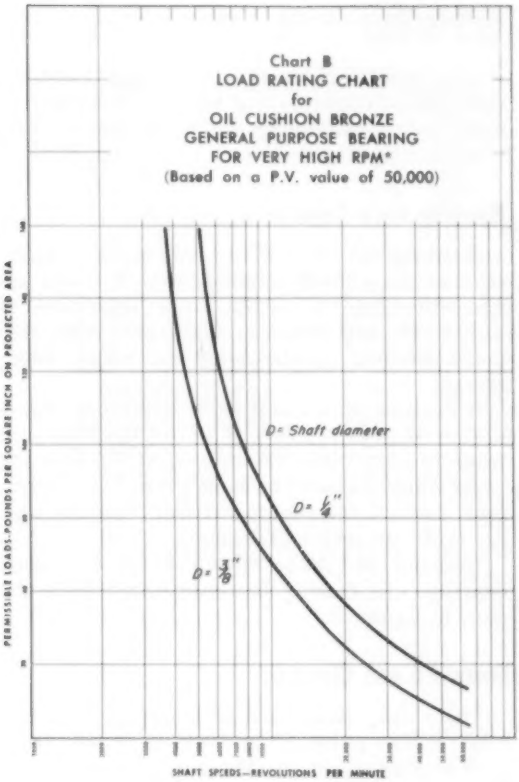
Many design engineers like to discuss their assignment with field engineers regarding the "nobility" of the bearing metal, availability, delivery, plant capacity and flexibility.

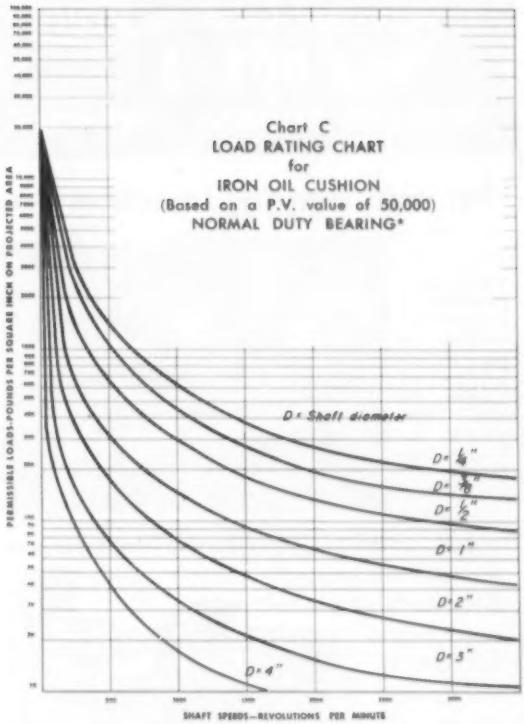
Assured of the quality, the sequence of design then generally conforms to the following pattern:

1. Load
2. Bearing ID — roughly; shaft diameter + bearing clearance
3. Housing bore
4. Housing bore
5. Press fit and close-in
6. Bearing ID — final size
7. Bearing length
8. Bearing wall thickness
9. Shaft or bearing clearance
10. Bearing assembly and sizing
11. Bearing ID after sizing
12. Subsequent lubrication when necessary
13. Factor of safety

Load

Normally the bearing load is determined by calculation, case histories, similar applications, or actual tests.





Bearing ID or Bore and Shaft Diameter

The first step then is the determination of the inside diameter or bore of the bearing. Immediately the purchasing agent, production executive and master mechanic enter the picture. The designing engineer, of course, decides whether the shaft is to be soft or hard, and the type and degree of finish. However, the purchasing department adivses of the price differential on shafting of various sizes and finishes.

Consulting the production department permits determination as to whether the shafting should be of "standard size," somewhat oversize, or undersize, fabricated to special tolerances, special finish, etc.

The master mechanic is consulted as to how he proposes to finish size the bore with regard to method and equipment. Meanwhile, the designing engineer is also studying bearings of standard size, load rating data — as Chart A, and by evaluation of the stated variables and the overall economy, he decides on the inside diameter of the bearing.

Of course, the approximate shaft diameter is determined by the load, length of span, and the specific requirements of the job. So far these figures, however, are round numbers, and the actual diameter of the shaft and bearing bore in decimals, including tolerances, is determined by the bearing engineer's final evaluation. He decides upon the bearing clearance being guided by Chart B. Here, the housing bore, press fit, and bore sizing stock are determined.

Housing Bore

The designing engineer of today appreciates that the narrower the tolerances on both the housing bore and the bearing, the greater

continued next page

A. J. LANGHAMMER . . . completed 4½ years machinist's and toolmaker's apprenticeship at American Tool Works; was graduated from University of Cincinnati with degrees of BME and ME; and started his professional career with Packard Motor Car Co. He has been master mechanic and works manager for C. G. Spring Co., and, since joining Chrysler Corp., has served in many capacities. He has been president of Amplex since 1937.

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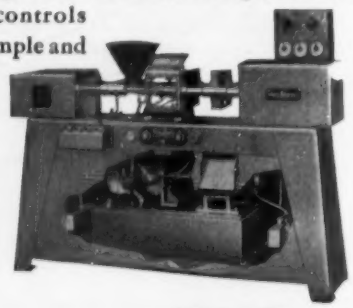

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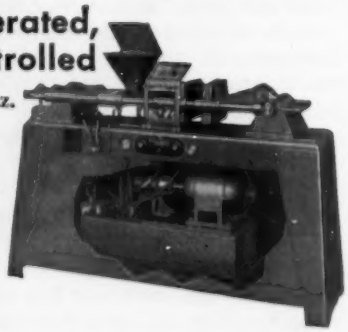

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is the cost. Fortunately the heavy duty, oil cushion, self-lubricating bronze bearing permits broad tolerances on both the housing bore and the bearing.

Housing Bore Tolerance

Holding the bore of the housing to a tolerance of ± 0.00025 is expensive. It costs appreciably less to work to a tolerance of ± 0.0005, and greater tolerances offer still more savings (particularly on large diameters).

A feature of the self-lubricating bearing is that with this product it is not necessary to work to very close tolerances on the housing bore. They do not break in assembly. Therefore, normal tolerances are very satisfactory for both housing and bearing.

Housing and bearing tolerances for large bearings can readily be determined from the data in Chart B.

Press Fit and Close-In

From case histories and charts such as Exhibit B, the press fit is decided. Again from case histories and the bearing field engineer, the designer computes the effect of "close-in" after assembly. See Chart B. On thin walls, the bearing close-in is roughly six tenths of the amount of the press fit: press fit in thousands times 0.60. On heavier walls it is less. In a bearing with a bore of 1.000, sizing stock after assembly normally ranges from 0.0005 to 0.0025.

Bearing ID Final Size

Having the shaft size, the bearing clearance, the amount of close-in and the stock required for finish sizing the bore, the final size of the bearing bore and tolerances as purchased is established. Tolerances should be liberal to achieve low cost since precision of the ID is effected through sizing after assembly.

Bearing Wall Thickness

Next the wall thickness is established. Here the designer is guided by case histories, test results, formula, and established practice.

Bearing OD

Having the wall thickness he now also knows the outside diameter in round figures. He consults with the master mechanics division and determines just how the bore will be finished and the bore tolerance. For ex-

continued on page 129

Exhibitors

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Space No.	Exhibitor
1	Kux Machine Co.
2	National Carbide Die Co.
3	Powder Metallurgy, Ltd.
4	Electric Furnace Co.
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7	Antara Chemical Div., General Aniline & Film Corp.
8	Harper Electric Furnace Corp.
9	Alloy Metal Powders, Inc.
10	New Jersey Zinc Co.
11	Ekstrand & Tholand, Inc.
12-14	F. J. Stokes Machine Co.
15	Lindberg Engineering Co.
16	Hoeganaes Sponge Iron Co.
17	Federal-Mogul Corp.
18	Yale & Towne Mfg. Co., Powdered Metal Products Div.
19	Trifari, Industrial Div.
20	Charles Hardy, Inc.
21	Kux Machine Co.
22	Glidden Co., Chemicals - Pigments - Metals Div.
23-24	Materials & Methods magazine
25-26	Easton Metal Powder Co.
27	Colonial Alloys Co.
28	Chicago Powdered Metal Products Co.
29-31	Metals Disintegrating Co., Inc. Baldwin-Lima-Hamilton Corp.
33	Radio Cores, Inc.
34	Metal Hydrides, Inc.
35	Precision Metal Molding magazine
36-37	Plastic Metals Div., National Radiator Co.

Metal Powder Association Tenth Annual Meeting

AGAIN this year, as it has for the past ten years, the Metal Powder Association will sponsor a national meeting and show devoted solely to powder metallurgy, the metal powder industry and the arts and sciences based on metal powders. Time and place: April 26-27-28, Drake Hotel, Chicago, Ill.

Both events, though sponsored by the Association and its members are open to anyone interested in powder metallurgy. Registration will open at 10.00 A.M., April 26, and will continue throughout the three days.

Technical sessions at the meeting are divided into (1) a general session devoted to papers relating to a variety of aspects of powder metallurgy, and (2) an electronic core session consisting of a separate all day-meeting devoted to subjects of specific interest to those in this specialized field.

The general session begins on Tuesday morning, April 27, under the chairmanship of T. L. Robinson, director of M.P.A. and president of the Powdercraft Corp.

10:30 A.M. "FRICTION AND LUBRICATION IN POWDER METALLURGY" — Dr. Henry H. Hausner and and Irving Sheinhartz, Sylvania Electric Products, Inc.

11:15 A.M. "LUBRICATION PRACTICES WITH METAL POWDER BEARINGS" — H. D. Krummel and J. R. Hicks, Socony-Vacuum Oil Co., Inc.

The afternoon session is under the chairmanship of P. E. Weingart, director of M.P.A. and manager, Metal Powder Sales, American Metal Co., Ltd.

2:00 P.M. "THE NON-DESTRUCTIVE TESTING OF SINTERED BRASS PARTS" — Julian Rossnick, Pitman-Dunn Laboratories, Frankford Arsenal.

2:45 P.M. "POWDER METALLURGY IN THE AUTOMOTIVE INDUSTRY" — Joseph Geschelin, Automotive Industries.

3:30 P.M. "AIRCRAFT APPLICATIONS FOR POWDER METALLURGY" — W. H. Woodward, National Advisory Committe for Aeronuatics.

4:15 P.M. "POWDER METALLURGY VERSUS OTHER PRECISION FORMING METHODS" — Charles S. Schroeder, The Yale & Towne Manufacturing Co.

The morning session on Wednesday, April 28, is under the chairmanship of G. A. Roberts, director of M.P.A. and vice president of Vanadium-Alloys Steel Co.

10:00 A.M. "THE MANUFACTURE OF SHEET METALS FROM METAL POWDER" — W. D. Jones, Powder Metallurgy Ltd.

10:45 A.M. "CARBIDE FLAME-PLATING IN POWDER METALLURGY" — M. A. Teter, Linde Air Products Co.

Abstracts of papers to be given at the MPA meetings later this month are presented beginning on page 54.

11:30 A.M. "SEMI-FORMED DRAWING STOCK BY POWDER METALLURGY" — Robert Steinitz, American Electro Metal Corp. and Frank Zaleski, Frankford Arsenal.

The electronic core session will meet all day, Tuesday, April 27, under the chairmanship of W. E. Cairnes, director of M.P.A. and president of Radio Cores, Inc.

10:30 A.M. "METHOD OF DETERMINING TEMPERATURE COEFFICIENT OF ELECTRONIC CORE MATERIALS" — R. H. Rodrian, C. K. Williams & Co.

11:15 A.M. "SOME ELECTRONIC APPLICATIONS OF IRON POWDER CORES" — David M. Hodgin, Collins Radio Co.

Among Speakers at Metal Powder Association Meetings . . .

H. D. Krummell

J. R. Hicks

Joseph Geschelin

M. A. Teter

W. D. JONES

Abstracts of MPA papers will reveal

Important New Applications For Metal Powder Products

Friction and Lubrication in Powder Metallurgy

By **Dr. Henry H. Haussner,** Manager of Engineering, and **Irving Sheinhartz,** Senior Engineer, Atomic Energy Div., Sylvania Electric Products, Inc., Bayside, N. Y.

An analysis of friction occurring during the process of compacting metal powders reveals five different types of friction. Methods for determining friction losses are described and the application of these methods for the evaluation of lubricants is discussed. It is shown that a careful selection of the type and amount of lubricant can be made in order to obtain best compacting results.

Lubrication Practices with Metal Powder Bearings

By **H. D. Krummell,** Chief Engineer, Chicago Div., and **J. R. Hicks,** Headquarters Staff Engineer, Socony Vacuum Oil Company, Inc.

Four phases of the lubrication of sintered metal powder bearings are discussed: Initial impregnation with oil; re-oiling before installation; lubrication in service; and the cleaning and re-oiling of used bearings. Lubrication principles, oil characteristics and the effect of oil additives are considered. Means for re-lubrication in service are illustrated.

Expanding Field of Application of Metal Powder Parts in the Automotive Industries

By **Joseph Geschelin,** Detroit Editor, Automotive Industries.

The nature of powdered metal parts being used in today's automobiles is described in detail, as well as those applications unique to powder metallurgy such as the newer metallic friction materials and special high density tungsten-nickel-copper parts.

Aircraft Applications of Powder Metallurgy Products

By **William H. Woodward,** Chief, Propulsion Division, National Advisory Committee for Aeronautics.

The applications of powder metallurgy in airframe and aircraft engine parts is discussed The importance of this method of fabrication is stressed in relation to new refractory high temperature materials. Some strength values are listed for an aluminum alloy (SAP) and several cermet compositions.

The Manufacture of Sheets by Powder Metallurgy

By **W. D. Jones,** M. Eng., Ph. D., F.I.M., Powder Metallurgy, Ltd., London, England.

There is increasing interest in the subject of "Powder Extraction Metallurgy," a title which the author has coined to describe the extraction of met-

continued on page 56

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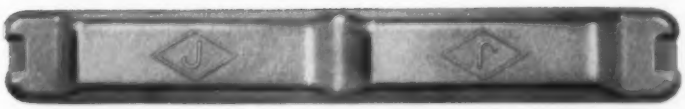

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als from their ores developing a metal powder as a finished product. Instead of melting such powders, it is more economical to use recently developed methods of directly rolling them to sheet or rod. Rolling processes of this type are described and costs discussed. Methods of manufacture of sheets in heat resisting alloys using a new powder flame spraying gun are also described.

Flame Plating in Powder Metallurgy

By **M. A. Teter,** Linde Air Products Co.

The flame-plating process is a method of applying tungsten carbide in layers of two to ten thousandths on most any base metal. A 2 to 5 micro-inch finish can be obtained by grinding and lapping. By flame plating, it is now possible to combine a hard, wear-resistant coating with desirable base metal characteristics such as toughness, conductivity, low weight, low inertia, coefficient of expansion, etc.

Semi-Formed Drawing Stock By Powder Metallurgy

By **Robert Steinitz,** Research Supervisor, American Electro Metal Corp.; and **Frank Zaleski,** Metallurgist, Frankford Arsenal, Philadelphia, Pa.

The iron powder for the production of cartridge cases is selected considering the required properties in the sintered piece. Performs in the shape of cups are molded, sinteredx, coined and resintered to supply pieces that are suitable for drawing. Drawing experiments are performed at Frankford Arsenal. Raw material, production conditions and equipment necessary are discussed, as well as the properties of the finished part.

Powder Metallurgy Versus Other Precision Forming Methods

By **C. S. Schroeder,** Manager-Director, Research and Product Development Div., Yale & Towne Manufacturing Co., Valley Forge, Pa.

The paper outlines various processes of precision forming of metal parts, including die casting, investment casting, extruding, screw machining, machining, stamping, shell mold casting and powder metallurgy. Advantages and limitations of each method are briefly outlined with greater detail devoted to powder metallurgy from the user's viewpoint.

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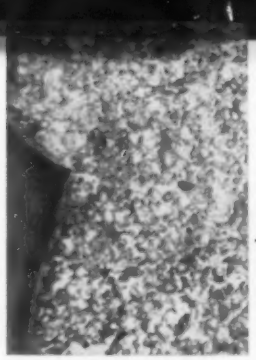
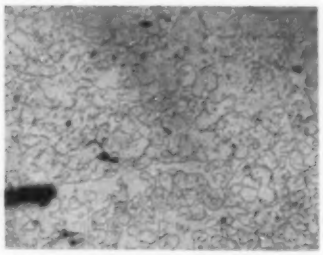


Brazing: it's one of the uses for

Infiltration of Powder Parts



AS A BRAZING METHOD . . .

Good and bad brazed joints are illustrated. Note that in Figure 1, above, the junction line indicated by arrow is practically indistinguishable. Figure 2 shows an unsatisfactory joint.

BY CLYDE C. CLARK, Factory Manager
Metallurgical Products Div.,
Thompson Products, Inc.

THE principle of infiltration has been known and used by the powder metal industry for many years. It might be well, however, to review briefly what it is and how it is accomplished before discussing its application and properties.

Basically, infiltration consists of the use of a liquid phase of lower melting material to fill the pores of a skeleton or matrix of higher melting material. To obtain fairly complete infiltration it is necessary that the matrix material have a limited solubility in the infiltrant. Probably the best example of limited solubility is in the copper infiltrant-iron skelton system. In this case the iron has a solubility of about 8 percent in the liquid copper. Infiltration is ordinarily accomplished in a dry reducing atmosphere and, in the case of the copper-iron system, at a temperature of 75 to 100 F above the melting point of the infiltrant. Since infiltration depends almost entirely on the capillary action between the pores and the infiltrant, the location of the infiltrant body with respect to the skeleton is not too critical as long as they are in contact.

Many products made by this process are in use today. For example: structural parts and jet engine compressor blades which utilize an iron or iron-copper skeleton infiltrated with copper or copper alloys; jet engine buckets and nozzle vanes and other temperature resistant applications using a titanium carbide or similar skeleton with an infiltrant of nickel-chromium, Inconel, cobalt-chromium or like material.

Most of the above examples except the structural parts, are somewhat specialized. It might be well to consider what infiltration has to offer the designer, manufacturer, and his potential customer. There are many applications of powder metallurgy where the ordinary low density part, 65-85 per cent dense, obtained by molding and sintering is entirely adequate. Other uses exist for the 90-95 per cent dense part obtained by the more expensive sinter, coin, resinter, recoin operations. The more recent hot coin method of obtaining high density is also being used more extensively as a means of obtaining higher density products. Since it appears that the powder metallurgist will be continually striving for higher densities, the possibility of infiltration should not be overlooked.

Turn the page to find SIX MORE WAYS to use infiltration

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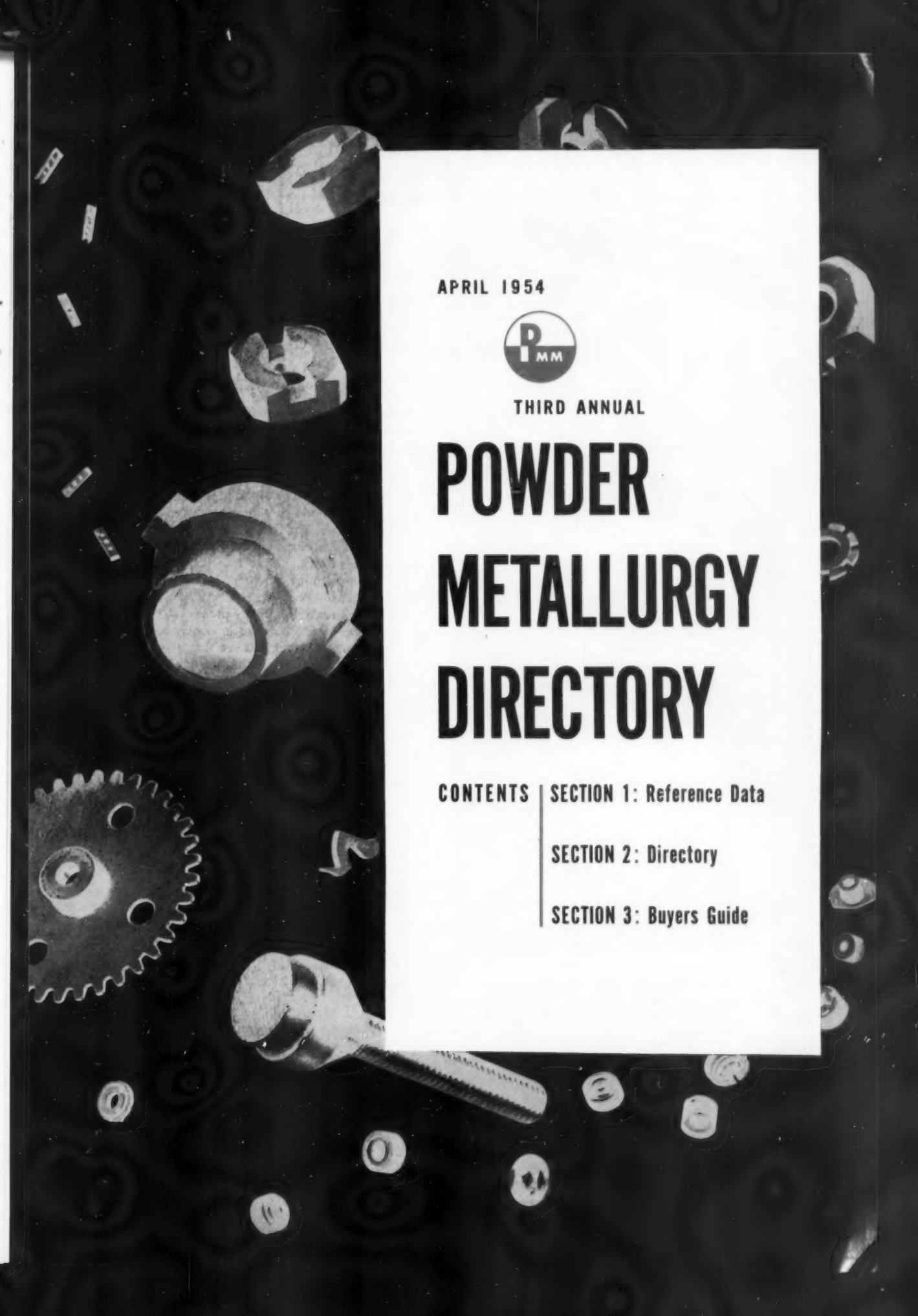
Here Are Many Features of Infiltrated Parts for Designers To Consider . . .

Infiltrated parts have a number of properties that are outstanding and useful:

1. HIGH DENSITY. Essentially all pores are filled and a part with 98-100 per cent density is obtained.
2. LOWER NOTCH EFFECT. By eliminating the pores, the notch effect is greatly reduced and the tensile strength and fatigue properties increased.
3. HARDENABILITY. In the case of the copper infiltrated iron skeleton use may be made of precipitation hardening because of the limited solubility of copper and iron. It is very common to obtain tensile strengths of 100,000 to 110,000 psi from an infiltrated and heat treated iron copper structure.
4. FINISHABILITY. Since the porosity is essentially eliminated, the product is an ideal base for further surface finishing operations, such as electroplating. This is particularly true where copper is used as the infiltrant and provides the ideal flash plate for subsequent deposition. A properly applied plate of nickel and chromium will exhibit salt-spray resistance equal to or better than that of type 410 stainless steel.
5. MACHINABILITY. Infiltrated products present no machining problem. In the case of the powder metal compressor blade unusual broach life was obtained resulting in marked savings in this operation.
6. SIMULTANEOUS PROCESS. The infiltration process may be conducted simultaneously with the sintering operation in many cases. This, of course, makes for an inexpensive operation, since the only additional expense is the cost of the infiltrant. There are several conditions under which it is preferable to sinter and infiltrate as separate operation, since the only additional expense is the cost gases are evolved during the sintering operation making it difficult to obtain a satisfactory surface on infiltration. When close dimensional control is desired, it is advisable to coin before infiltration, making separate sintering and infiltrating operations necessary. Some sizing can be done on the infiltrated product but greater metal movement and lower tooling costs will be realized by obtaining the desired dimensional control from coining the sintered part.
7. BRAZING. Infiltration, since it is essentially a modified brazing operation, offers a useful means of joining two or more relatively simple sections together to form a more complex part. In performing such an operation normal brazing precautions should be followed. For example, adequate fixtures should be provided and the clearance between the sections should be held to a mini-

continued on page 126

CLYDE C. CLARK . . . is factory manager, Metallurgical Products Div., Thompson Products, Inc., and is in charge of powder metallurgy operations. He began with Thompson in 1942 as chemical engineer and has advanced through various positions including superintendent and assistant factory manager.



APRIL 1954

THIRD ANNUAL

POWDER METALLURGY DIRECTORY

CONTENTS

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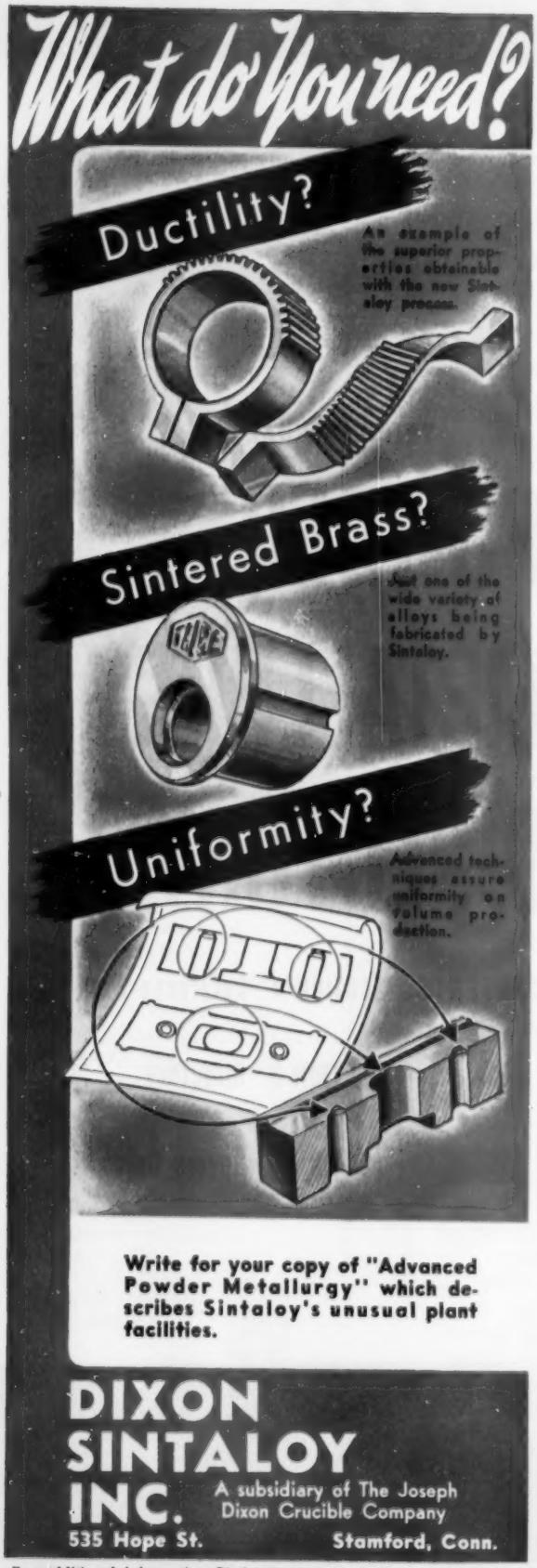
SECTION 2: Directory

SECTION 3: Buyers Guide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Contents of section 1

THE following reference tables of characteristics of metal powders, and of parts produced from metal powders, indicate only the **nominal** or **typical** properties of these materials. The figures listed in these charts have been obtained from the manufacturers listed below. It must be emphasized that these are presented largely for their relative or comparative value among the particular materials or with respect to cast or solid materials. Hardness values, in particular, are only of value in a relative way because the porosity of powder metal materials prevents true evaluation of this property by conventional tests.

Because of the nature of the powder metal process, different items made of the same material may exhibit an appreciable difference in properties, depending upon the size, shape, reaction to processing conditions, etc. In fact, different sections of the same piece may show some difference in properties. Therefore, each part must be considered and analyzed individually to assure satisfactory properties, not only in the part as a whole, but also in a particular section if it has critical requirements.

The following data **should not be used for specification or inspection purposes.** The proper specifications, tests and inspection procedures for each specific item should be established and agreed upon mutually by the fabricator and the user. Under proper specifications, the uniformity of the properties of a particular powder metal part, from piece to piece and lot to lot, is very good.

Page 61 — Typical properties of metal powder compacts

Key numbers of manufacturers listed:

1. Bound Brook Oil-less Bearing Co.
2. Chicago Powdered Metal Products Co.
3. Dixon Sintaloy, Inc.
4. Ferro Powdered Metals, Inc.
5. General Powdered Metals, Inc.
6. International Powder Metallurgy, Inc.
7. Johnson Bronze Co.
8. Keystone Carbon Co.
9. Metal Powder Products Corp.
10. Michigan Powdered Metal Products Corp.
11. Powdercraft Corp.
12. Pow-Met Industries
13. United States Graphite Corp.
14. Yale & Towne Mfg. Co. Powdered Metal Products Div.

Page 65 — Typical properties of metal powders

Key numbers of manufacturers listed:

1. American Metal Co., Ltd.
2. Antara Chemical Div., General Dyestuff Corp.
3. Ekstrand & Tholand, Inc. & Hoeganaes Sponge Iron Corp.
4. Glidden Co.
5. Greenback Industries, Inc.
6. Charles Hardy, Inc.
7. A. Johnson & Co., Inc.
8. Magnetic Powders, Inc.
9. Malone Metal Powder Co.
10. Metal Powders, Ltd.
11. Metals Disintegrating Co.
12. New Jersey Zinc Sales Co.
13. Plastic Metals Div., National Radiator Corp.
14. Pyron Corp.
15. Reynolds Metals Co.
16. Vanadium-Alloys Steel Co.
17. Easton Metal Powder Co.
18. Metal Hydrides, Inc.

Typical Properties of Powder Compacts

Manufacturer		Composition							Density g/cc	Ultimate Tensile psi	Yield Strength psi	Elongation % in 1"	Rockwell Hardness	Yield in comp.*
Code No.	Designation	% Fe	% Cu	% C	% Sn	% Zn	% Ni	% Other						
COPPER BASE														
1	H		89		9.75			1.25	6.6	14700			30–70H	32000
1	3-H		89		9.75			1.25	6.3	12000			25–50H	26000
1	R		87		9.5			3.5	6.6	15500			30–60H	37500
2	12		80			20			7.5	34100				
2	24		90–94		6–10				6.2	13000				
2	26		90–94		6–10				7.0	25000				
3	Z901		90			10			8.0	32000		18		
3	Z901P		90			10		.5P	7.9	30000		0.5		
3	Z851		85			15			7.85	35000		15		
3	Z802PB		80			20		1.5Pb	7.65	29000		7–12		
3	N6418		64			18	18		7.89	42000		14		
3	Z7030		70			30			7.6	35000		13		
3	B900		92		8				6.6	15000				
3	B901		90		10				6.6	18000				
3	B903		90		10				7.5	40000				
3	B904		92		8				7.2	25000				
4	B8501		89.5	1.0	9.5				6.4	12500		2	50 (1)	11000
4	B8502		90		10				6.4	16000		5	40 (1)	14500
4	S8502		90		10				6.6	17000		6	50 (1)	16000
5	P110S		88–92		8–12				6.2	14000	11000			
5	P110H		88–92		8–12				6.7	16500	15000			
5	2-101		90			10			7.9	28000	11000			
6	BR901		90		10				6.2	15000				13000
6	BZ901		90			10			7.5	26000				34000
6	BZ802		80			20			7.5	30000				35000
7	90		87.5	1.5	10.5			0.5	6.4–6.8	12000			25 (1)	
7	Std.		83–87	1.5	9.5-10.5			2.0–4.0Pb	6.4–6.8	12000			25 (1)	
7	FA		95.0	.5–2.0				3.0	5.8–6.2	15000		1.0	40 (1)	
8	C-64		90		10				6.4	14000		2	53H	11000
8	E-183		82–88	1.75	9.5–10.5	.75	.35	2–4Pb	6.5	14000		2	53H	11000
8	D-692	25	65	(bal. Zn, Sn., etc.)					6.2	16000		1	57H	14000
8	D-10-1		75			16 (bal. graphite, Sn, etc.)			6.7	10000		2	50L	6000
8	V-1		78.5			20		1.5Pb	7.5	21000		15	70H	12000
8	V-3		64			18	18		7.7	32000		10	92H	18000
9	4000		89	.5	10			.5	6.6–7.0	12000				
11	PC800		90		10				6.8	16000		5	30 (1)	
11	PC826		87		9			4Pb	6.4	10000		4		
11	PC886		64			18	18		6.8	24000		6		
13	81		x	x	x				6.8	13000				
13	61		x		x				6.8	16800				
13	168		x	x	x			Pb	6.7	11200				
13	183		x		x		x	Pb	6.8	15000				
13	263		x		x		x		6.9	25000				
13	273		x			x	x		6.7	17000				
13	138		x						7.4	20100				
13	272		x			x			6.8	26000				
14	BZ3		90			10			7.0–7.3	15–17300		3.5–6.1	30–70H	
14	BZ4		85			15			7.3–7.6	16–20600		5.1–8.6	20–70H	
14	BZ5		78.5			20		1.5Pb	7.3–7.7	16–25900		5.2–9.1	25–80H	
14	BZ11		78.5			20		0–1Pb	7.3–7.6	17–27600		6.6–22.3	45–90H	
14	B50		90		10				6.9–7.1	14–16700		6.8–7.1	60–70H	
14	W55		90		10				7.7–8.3	19–33600		8.9–15.6	45H–25B	
14	W60		64			18	18		7.3–7.7	19–22700		2.8–4.6	65H–30B	

*0.1% offset psi

Typical Properties of Powder Compacts — cont.

Manufacturer		Composition							Density g/cc	Ultimate Tensile psi	Yield Strength psi	Elongation % in 1"	Rockwell Hardness	Yield in comp.*
Code No.	Designation	% Fe	% Cu	% C	% Sn	% Zn	% Ni	% Other						
IRON BASE														
1	61–P	90	10						6.1	30000			80–100H	81000(2)
1	55–P	95	5						5.5	12000			25–60H	37000
1	59–I	100							5.9	12000			30–60H	79000(2)
2	42	92	8						5.5	32000				
2	47	92	8						5.9	40000				
2	61	99		1					5.8	29000				
2	65	99		1					6.0	48000				
2	98	99							7.0					
3	CI–100	98.9		1					6.4	30000				
3	S–200	97		1				2	6.7	70000				
3	L–1010	90	10	1					6.0	55000				
3	LI–1010	90		1				9	7.3	75000				
3	EC–100	99.5						.5	8.0	21000		9–12		
3	HD5	98		.85					7.6	100000		8		
3	I–1	98							7.7	135000		18		
3	I–2	98							7.7	81000		18		
3	I–3	98							7.5	105000		12		
4	S–6804	85	15						5.8	34000		3	50 (1)	44000
4	S–6801	76	24				(infiltrated)		6.6	60000		3	140 (1)	75000
5	P–150S	92–98	2–8						5.4	16000				30000
5	P–150H	92–98	2–8						5.7	20000				56000
5	P–120	87–93	8–13						5.9	40000				50000
6	Fe901	90	10						5.9	40000				30000
6	Fe955	95	5						5.6	20000				30000
7	FB5	Bal.	5.0					3.0	5.8–6.2	13000		1.3	30 (1)	
7	FB10	Bal.	10.0					3.0	5.8–6.2	30000			45 (1)	
7	FB20	Bal.	20.0					3.0	5.8–6.2	30000		1.0	45 (1)	
8	F–101	99	1						6.1	16000		1	60H	22000
8	F–125	95	5						5.4	18000		0.5	75H	25000
8	F–200	90	10						5.8	30000		0.5	94H	32000
8	Z–3	75	25				(infiltrated)		7.5	65000		1.5	75B	70000
8	Z–4C	100		(carburized and water quenched)					7.6	52800		1	48C	37600
8	IZ–4	100		(fully annealed condition)					7.4	43200		8.7	37B	23600
8	Z–4	100		(fully annealed condition)					7.6	45500		18.5	42B	25200
9	1000	99		0.5				0.5	5.7–6.1	15000				
9	1000D	99		0.5				0.5	6.1–7.3	20–50000				
9	1000Cu	85–90	10–15	0.5				0.5	7.2–7.6	60–100000				
9	1290	89	10	0.5				0.5	5.8–6.2	30000				
9	1295	94	5	0.5				0.5	5.8–6.2	40000				
10	41	90	9	0.7				Bal.	5.8	26000	25000	2.0	28B	40000
10	42	89	10	0.9				Bal.	6.2	40000	36000	2.0	34B	54000
10	X–14	78	20	0.8				Bal.	7.4	75000	69000	2.0	85B	70000
10	40	99		0.8				Bal.	5.8	26000	25000	2.5		37000
11	PC600	98.5		1.5					6.1	24000		1	60 (1)	
11	PC626	97	3						6.1	25000			60 (1)	
11	PC627	90	10						6.2	30000		1	90 (1)	
11	PC628	85	15						6.2	32000		3	90 (1)	
1	PC629	75	25						6.2	34000		4	90 (1)	
11	PC632	100			(copper impregnated)				7.0	65000		7	140 (1)	
12	1000	99.95						0.05	7–7.3	36200	24000	10		
12	2000	99.95						0.05	7.5	60000	55000	5		
12	3000	99.95						0.05	7.5	50000	30000	25		
12	4000	99.95			(carburized, light case)			0.05	7.3	78000		2		
12	4000	99.95			(carburized, light case)			0.05	7.0	95000		0		
12	5000	99.95			(carburized, light case)			0.05	7.5	70000		2–4		

*0.1% offset psi

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Typical Properties of Powder Compacts — cont.

Manufacturer		Composition							Density g/cc	Ultimate Tensile psi	Yield Strength psi	Elongation % in 1"	Rockwell Hardness	Yield in comp.*	
Code No.	Designation	% Fe	% Cu	% C	% Sn	% Zn	% Ni	% Other							
IRON BASE															
12	6000	99.95			(carburized, heavy case)			0.05	7.5	200000		0–1	62C		
12	7000	99.95			(carburized, heavy case)			0.05	7.5	170000	165000	2–4			
13	167	x							6.0	16000					
13	78	x	x	x					6.0	29000					
13	249	x	x	x					6.1	37200					
13	230	x								17000					
13	277	x								18000					
13	266	x	x	x				Pb	6.0	24000					
13	86	x	x	x					6.0	34000					
14	E10	100							5.7–6.2	14–25500		2.8–5.7	70H–40B		
14	E66	100							6.4–6.8	21–28400		3.3–6.6	0–50B		
14	E70	100							6.9–7.7	33–80900		3.8–12.3	20–90B		
14	B27	93	7						5.3–5.8	18–32500		1.2–2.0	0–50B		
14	W30	93	7						5.8–6.2	23–35700		1.8–3.1	20–66B		
14	W40	93	7						6.2–6.8	49–66400		1.9–2.2	30–76B		
14	W63	80	20						6.4–6.8	27–44200		1.3–2.1	30H–10B		
14	W100	80	20		(infiltrated)				7.6–8.2	66–100200		3.0–5.2	50–100B		
14	Z10	100		(carburized and quenched)					5.7–6.2	31–57200			60–62C	(3)	
14	Z66	100		(carburized and quenched)					6.4–6.8	41–73100			60–62C	(3)	
14	Z70	100		(carburized and quenched)					7.0–7.7	69–84300			60–62C	(3)	
14	Z150	80	20	(carburized and quenched, infiltrated)					7.6–8.2	98–147800			60–62C	(3)	

(1) Brinell hardness (2) For 0.3% offset (3) Micro hardness *0.1% offset psi

Typical Properties of Metal Powders

Manufacturer		Composition						Hyd. Loss	App. Density*	Flowability**	Green Density†	Screen Analysis					
Code No.	Designation	% Fe	% Cu	% C	% Si	% Al	% Others					+100	−100 +150	−150 +200	−200 +250	−250 +325	−325
ALUMINUM																	
11	13					99			1.00			20 mesh control screen					30.0
11	33					99			0.90			30 mesh control screen					35.0
11	44					99			0.90			40 mesh control screen					40.0
11	101					99			0.90			100 mesh control screen					75.0
11	105					98			0.40			100 mesh control screen					99.0
11	201					98.5			0.80			200 mesh control screen					85.0
15	12120	0.5			0.2	98.8			0.85			28.0	51.0	16.0	3.0	1.0	1.0
15	40	0.5			0.2	98.8			0.90			16.0	13.0	13.0	5.0	12.0	41.0
15	120	0.5			0.2	98.7			0.90			0.0	0.5	3.0	3.0	8.5	85.0
15	200	0.5			0.2	98.6			0.90			0.0	0.0	trace	0.2	0.2	95.0
15	400	0.5			0.2	98.3			0.75			0.0	0.0	0.0	0.0	trace	99.9
BRASS																	
							Zn						!		!		
6			90.0				10.0					2.0	15 to 35		15 to 35		60.0
6			90.0				10.0	0.5P				2.0	15 to 35		15 to 35		60.0
6			85.0				15.0					2.0	15 to 35		15 to 35		60.0
6			70.0				30.0					2.0	15 to 35		15 to 35		60.0
6			70.0				30.0	0.3P				2.0	15 to 35		15 to 35		60.0
6			78.5				20.0	1.5Pb		3.0	24-28	2.0	15 to 35		15 to 35		60.0
12	1116		50.0				50.0					2.0	15 to 35		15 to 35		60.0
12	1104		70.0				30.0	0.3P				2.0	15 to 35		15 to 35		60.0
12	1130		80.0				20.0					2.0	15 to 35		15 to 35		60.0

* g/cc ** sec./50g sample † with 1% Stearate @ 60,000 psi

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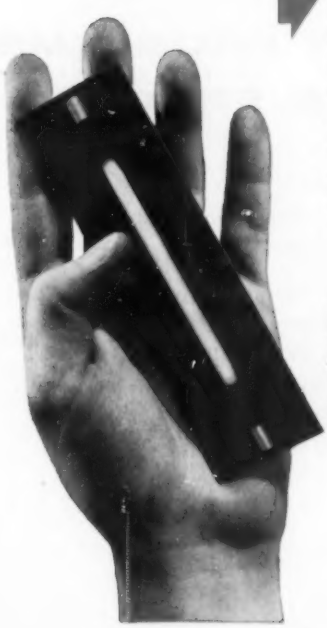

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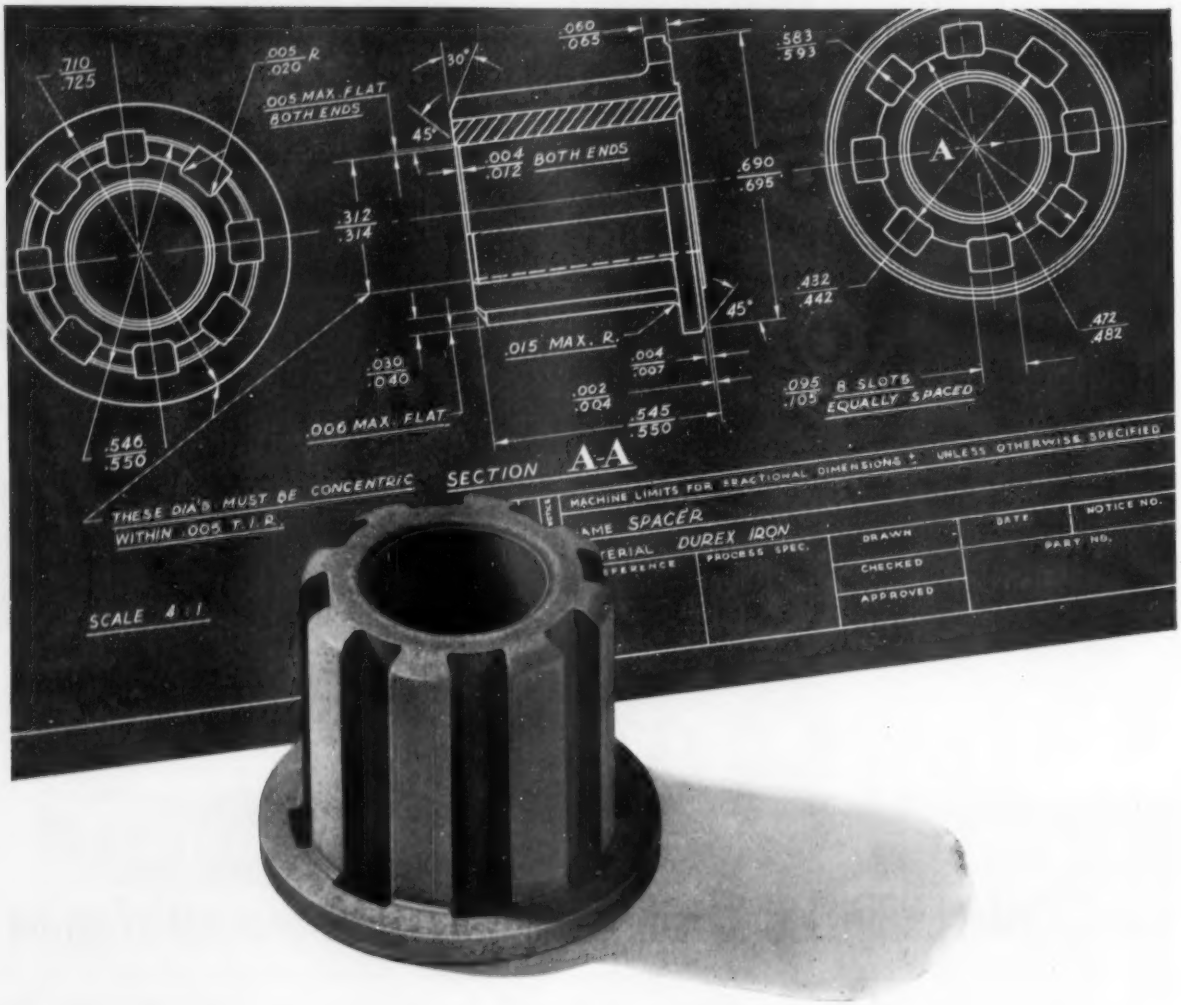

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DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

METAL POWDER PARTS

Typical Properties of Metal Powders — cont.

Manufacturer		Composition						Hyd. Loss	App. Density*	Flowability**	Green Density†	Screen Analysis					
Code No.	Designation	% Fe	% Cu	% C	% Si	% Al	% Others					+100	−100 +150	−150 +200	−200 +250	−250 +325	−325
BRASS																	
12	1163		78.5				20.0 1.5Pb					2.0	15 to 35		15 to 35		60.0
12	1110		90.0				10.0					2.0	15 to 35		15 to 35		60.0
12	1181		89.0				9.5 1.5Pb					2.0	15 to 35		15 to 35		60.0
BRONZE																	
							Sn										
6			80.0				10.0Pb 10.0	0.3	5.0	15		0.2	2-5	13-23	6-13	13-23	43-58
11			90.0				10.0		2.2			100 mesh control screen					50.0
11	34		bal.				5-7		4.0			30 mesh control screen - 90% plus					40
11	36		bal.				5-7		4.0			30 mesh control screen - 90% plus					60
11	46		bal.				7.2-9.7		4.0			40 mesh control screen - 90% plus					60
11	61		bal.				8.2-9.7		4.0			60 mesh control screen - 90% plus					100
11	68		bal.				8.2-9.7		4.0			60 mesh control screen - 90% plus					80
11	83		bal.				9-10.5		4.0			80 mesh control screen - 90% plus					150
11	103		bal.				9-10.5		4.0			100 mesh control screen - 90% plus					325
12	1403		90.0				10.0					2.0	15 to 35		15 to 35		60.0
12	1410		93.5				1.5Pb 5.0					2.0	15 to 35		15 to 35		60.0
COPPER																	
1	AJL		99.5					0.30	3.5	24		0.8	7-17	17-27	3-10	15-25	35-45
1	LB		99.5					0.30	2.45	33		0.2	3-13	17-27	5-12	18-28	33-43
1	A		99.5					0.30	2.40	32		0.5	5-15	25-35	6-13	19-29	22-32
1	HB		99.5					0.30	2.75	30		0.2	1-11	14-24	5-12	15-25	42-52
1	LU		99.4					0.40	2.30	35		0.2	1-10	9-19	2-9	16-26	50-60
1	U		99.4					0.40	2.50	35		0.2	1-10	9-19	2-9	12-22	53-63
1	HU		99.4					0.40	2.70	32		0.2	1-10	7-17	2-9	13-23	54-64
1	M		99.25					0.50	2.50	40		0.2	1-6	5-15	1-6	10-20	63-73
1	LC		99.00					0.75	1.50			0.1	0.5	4.0	1.5	2-7	90.0
1	C		99.00					0.75	2.10			0.1	0.5	4.0	1.5	2-7	90.0
1	B		99.50					0.30	2.50	32		0.2	1-11	13-23	3-10	17-27	43-53
4	40JB	0.10	99.5		0.05	nil		0.35	3.0	30	7.7	95	5				
4	40RL	0.10	99.5		0.05	nil		0.35	3.0	30	7.6	60	40				
4	100RXA	0.10	99.4		0.05	nil		0.30	2.8	30	7.4	2	14	24	4	17	39
4	150RXA	0.10	99.4		0.05	nil		0.30	2.8	30	7.30	0.5	1.5	10	2	18	68
4	150RXS	0.10	99.4		0.05	nil		0.30	2.6	35	7.30	0.5	1.5	10	2	18	68
4	200RL	0.15	99.0		0.05	nil		0.80	2.4	nil	7.20	trace	trace	0.5	3.5	6	90
4	500RL	0.15	99.0		0.05	nil		0.80	2.2	nil	7.00	trace	trace	trace	0.5	1.5	98
5			99.5					0.3	1.90	30	7.9	trace	.1-.3	8-21	8-20	8-20	bal.
6		See listings for producer No. 1 above															
9			99.3					0.5	1.01	nil		36.9	12.4	14.5	20.2		16.0
11	105		97.5						1.50			200 mesh control screen					98.0
11	110		96.0						1.80			100 mesh control screen					85.0
11	151		99.0						2.40			150 mesh control screen					65.0
11	165		99.0						2.60			150 mesh control screen					65.0
11	201		98.5						2.30			200 mesh control screen					85.0
11	410		99.0						1.50			90	40 mesh control screen				
IRON							O_2	N_2									
2	E	98.1	nil	0.6	nil	nil	0.1	0.55	2.5			nil	nil	nil	trace	trace	100
2	TH	98.2	nil	0.5	nil	nil	0.1	0.55	2.5			nil	nil	nil	trace	trace	100
2	SF	98.2	nil	0.5	nil	nil	0.1	0.55	2.5			nil	nil	nil	trace	trace	100
2	C	99.5	nil	0.4	nil	nil	0.01	0.00	2.5			nil	nil	nil	trace	0-0.5	99.5-100
2	HP	99.6	nil	0.01	nil	nil	0.01	0.00	2.5			nil	nil	nil	trace	0.5-2	98.0-99.5
2	L	99.6	nil	0.01	nil	nil	0.01	0.00	1.8			nil	nil	nil	trace	5.20	80-95

* g/cc ** sec./50g sample † with 1% Stearate @ 60,000 psi

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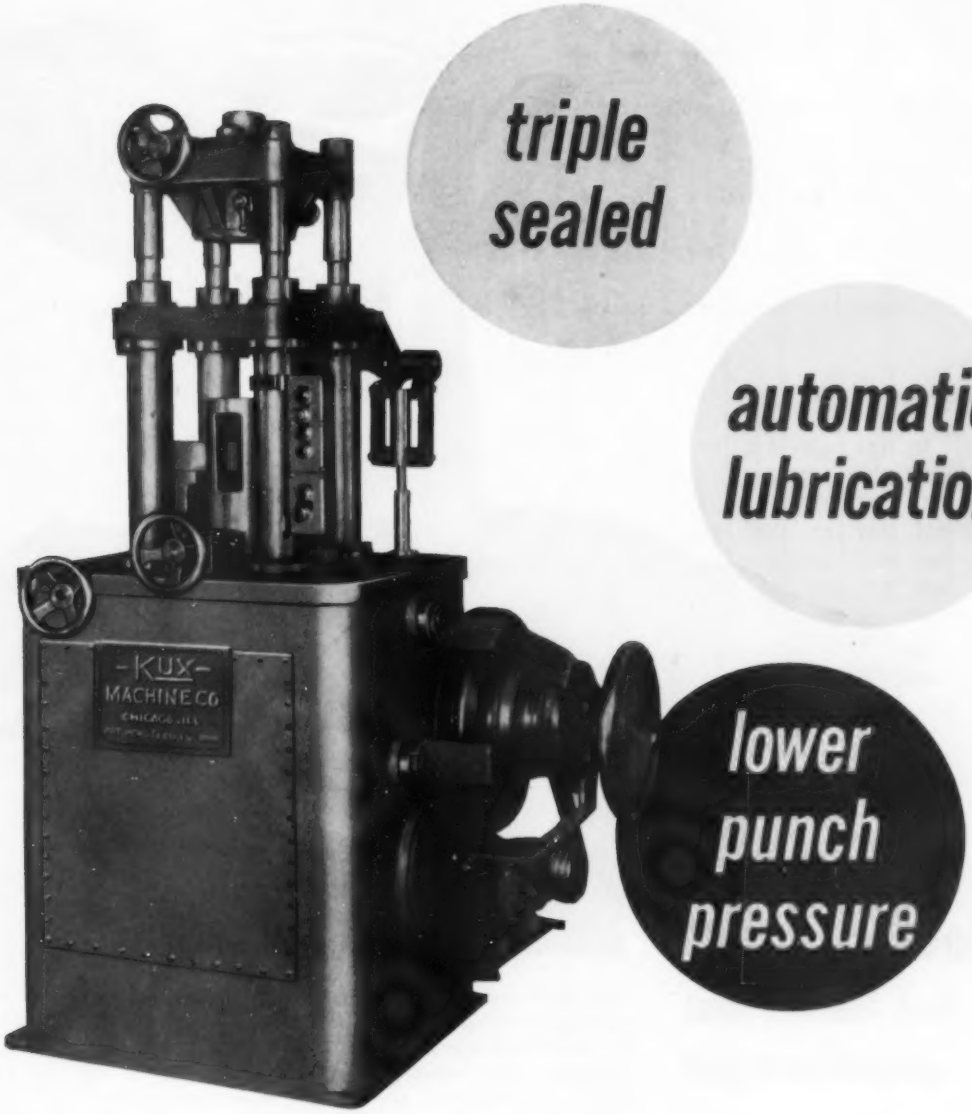

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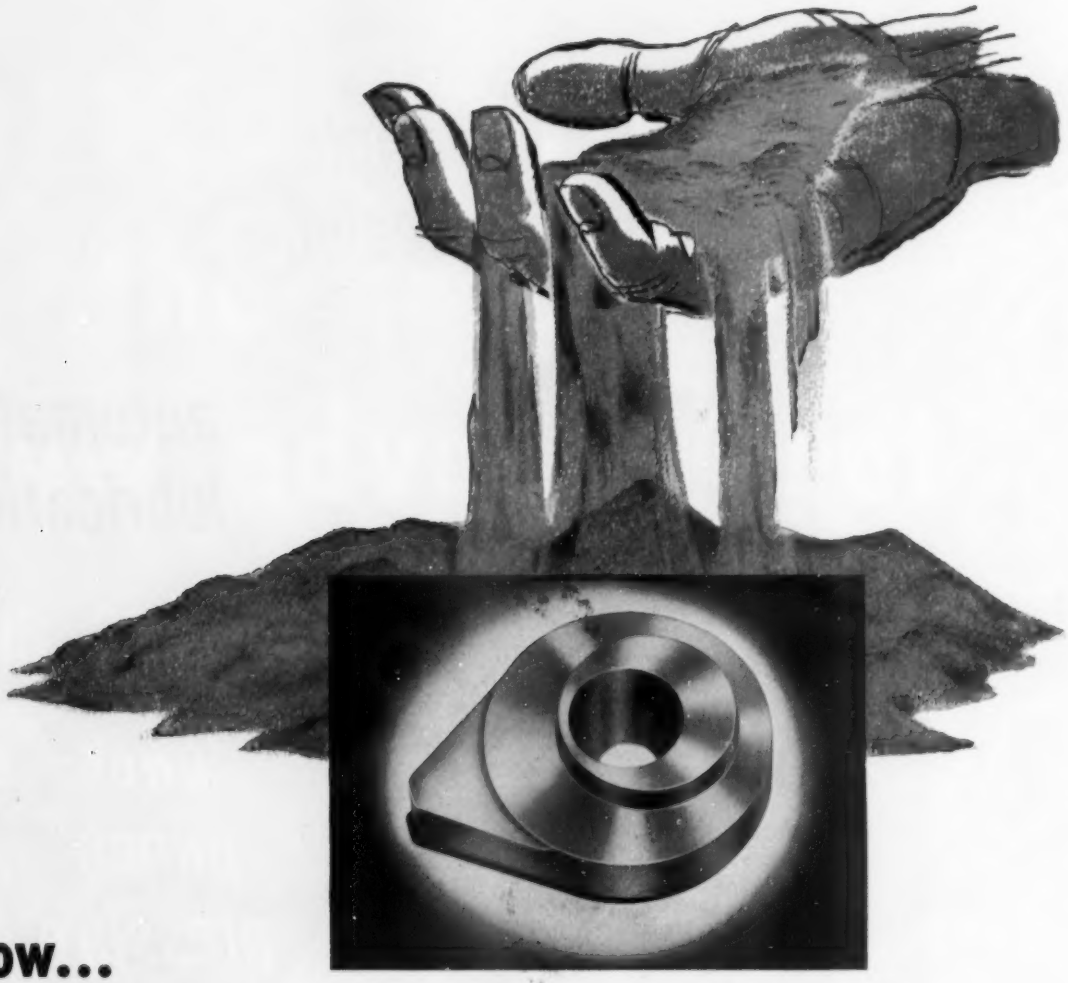

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Typical Properties of Metal Powders — cont.

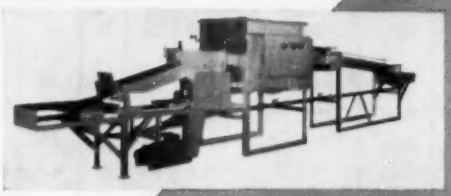
Manufacturer		Composition							Hyd. Loss	App. Density*	Flowability**	Green Density†	Screen Analysis					
Code No.	Designation	% Fe	% Cu	% C	% Si	% Al	% Others						+100	−100 +150	−150 +200	−200 +250	−250 +325	−325
IRON																		
3	Ancor 80	97.5+							0.8	2.3	35	6.17	5-10	10-20	15-20	3-5	20-30	25-35
6	I	98.5		0.20	0.25				1.0	2.9	25		1.0	12.0	21.0	11.0	21.0	34.0
6	V	98.5		0.20	0.25				1.0	2.40	30	6.0	1.0	12.0	21.0	11.0	21.0	34.0
6	100	99.0		0.04					0.09	2.3	34	6.5		14.0	20.0	5.0	21.0	40.0
7	HVA std.	99.7	0.01	0.05	0.02	.06Mn	.01Ni	.01P	0.5	3.3	24	6.8	10-20	20-30	-	20-30	25-30	-
7	HVA sponge	99.7	0.01	0.05	0.02	.06Mn	.01Ni	.01P	0.5	2.6	30	6.6	1-5	10-20	20-30	5-10	15-25	15-25
7	HVA ex. fine	99.6	0.001	0.08	0.02	.08Mn	.001Ni	.001P	2.0	2.8	30	4.9						100
8	21	98	nil	0.05	0.2	trace	tr-Ni		0.8	2.5	27	6.5	1.3	7.5	22	9.5	25.7	34
8	15	93	5-5.5	0.05	0.2	trace			0.8	2.5	23	6.3	2.9	16.6	26.4	6.5	7.9	29
8	18	90	8-8.5	0.05	0.2	trace			0.8	2.5	27	6.6	1.7	23.9	23.1	13.1	17.2	21.1
10	MP-1	98.4		0.10	0.15				0.8	2.4	33		2.5	17.5	21.0	14.0	15.0	30.0
10	MP-2	98.4		0.01	0.15				0.8	2.5	30		0.5	11.5	17.0	15.0	16.0	40.0
10	MP-4	98.4		0.10	0.15				0.8	2.8	28		0.3	9.7	14.0	16.0	18.0	42.0
10	MP-5	87.4	8.0	0.15	0.15		3.0Ni		0.8	2.5	33		2.5	17.5	21.0	15.0	16.0	28.0
10	MP-7	97.0		0.08	0.15	.09Mn	1.0Mo		1.0	2.2	37		0.2	13.0	18.0	13.2	14.0	41.0
11	180	98.0								2.5			100 mesh control screen					40.0
11	182	98.0								2.3			100 mesh control screen					40.0
11	185	98.0								1.85			100 mesh control screen					40.0
13	A-210	95.5		0.02	0.007	.003Mn			0.4	2.5	35	6.7	1.0	18	22	5	19	35
13	A-220	98.7		0.03	0.007	.003Mn			1.2	2.2		6.6			1.5	2.5	15	81
13	A-230	98.6		0.03	0.007	.003Mn			1.3	2.1		6.5				0.5	1.5	98
13	24	99.2		0.04	0.007	.003Mn			0.5	2.4		6.7	1.0	17	14	8	15	45
13	B-210	98.0		0.17	0.060	.250Mn			1.0	2.7	27	6.3	0.2	11	24	6	23	36
13	B-211	98.0		0.25	0.06	.25Mn			0.9	2.7	30	6.5	1.0	12	22	6	24	35
13	B-212	98.0		0.10	0.10	.03Mn			0.7	2.5	30	6.3	2.0	30	25	5	17	21
13	B-214	98.0		0.05	0.08	.03Mn			0.3	2.7	27	6.5	0.5	25	25	6	20	24
13	B-215	98.0		0.05	0.10	.03Mn			0.6	2.9	24	6.3	0.4	20	22	6	22	30
13	23	97.0		0.35	0.06	.25Mn			2.50	1.6	93	5.5	94.0		4		2	
14	-100	98.25		0.02	0.09				1.0	2.25	31	5.85		14.5	21.5	14.5	10.8	38.7
17	RZ	98.7		0.08			.38Mn	.03S	0.89	2.55	30	6.3	trace	17.7	25.5	8.0	28.1	20.7
17	RZ-A	98.7		0.08			.38Mn	.03S	0.75		26			6.4	13.8	3.5	31.9	44.3
17	RZ-B	98.7		0.08			.38Mn	.03S	0.75		19.6			21.7	25.0	9.9	16.6	26.7
LEAD																		
4	40B								0.5	5.5	40		65					
4	100B								0.5	4.75			2					75
4	200B								0.5	4.75			1					95
4	F								0.5	4.25							10	90
4	SF								0.5	4.25							1	99
11	101						99.5Pb			4.00			100 mesh control screen					95
11	102						99.5Pb			4.50			100 mesh control screen					85
11	104						99.5Pb			5.00			100 mesh control screen					40
11	201						99.5Pb			3.50			200 mesh control screen					98
MANGANESE							Mn											
11	101						99.0			2.6			100 mesh control screen					50
11	201						99.0			2.6			200 mesh control screen					75
11	301						99.0			2.6			325 mesh control screen					95
13	E-110	.001					98.5		1.0	3.2				10	10	2	6	72
13	E-120	.001					98.0		1.5	2.8						1	7	92
13	E-130	.001					97.5		2.0	2.6							.1	99.9

* g/cc ** sec./50g sample † with 1% Stearate @ 60,000 psi

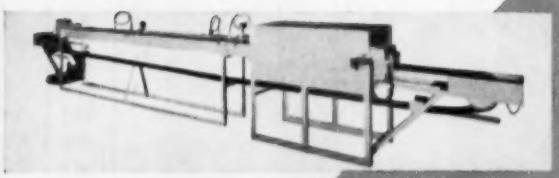
"CERTAIN CURTAIN"

CONTROLLED-ATMOSPHERE HEAT-TREATING EQUIPMENT

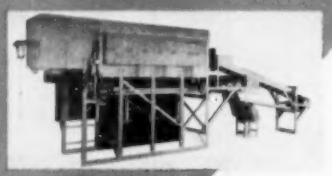
Hayes famous "Humpback" Conveyor Furnace



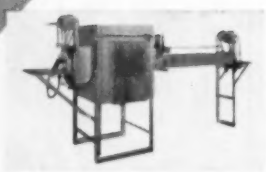
Exclusive Hayes Design Patent applied for



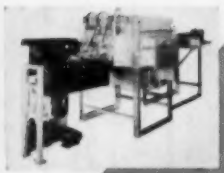
Conveyor Sintering



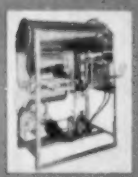
Combination Sintering and Hardening, Conveyor



Manual Pusher Sintering

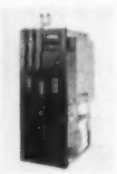


Hydraulic Pusher Sintering



Exothermic Atmosphere Generator

Dissociated Ammonia Atmosphere



Endothermic Atmosphere Generator

for BEST results in SINTERING Ferrous and Non-ferrous Compacts

FOR DETAILS OF SINTERING FURNACE EQUIPMENT

SEND FOR HAYES CATALOG No. 112.

HAYES EQUIPMENT FEATURES:

— absolute production control over time, temperature and atmosphere in both sintering and hardening.

— highest degree of uniformity throughout the production cycle.

— scale-free, clean or bright sintering.

— retained properties of color and carbon content (can increase carbon content if desired).

— controlled carbo-nitriding of ferrous sintered parts.

C. I. HAYES, INC.

103 BAKER STREET — PROVIDENCE, R. I.

ELECTRIC CERTAIN CURTAIN FURNACES

AGENTS IN PRINCIPAL CITIES

For additional information Circle No. 40 on the Reader Service Card

Typical Properties of Metal Powders — continued

Manufacturer		Composition						Hyd. Loss	App. Density*	Flowability**	Green Density†	Screen Analysis					
Code No.	Designation	% Fe	% Cu	% C	% Si	% Al	% Others					+100	−100 +150	−150 +200	−200 +250	−250 +325	−325
NICKEL																	
							Ni										
11	102						99.25		2.6			100 mesh control screen					50
11	152						99.00		2.6			150 mesh control screen					75
11	202						99.00		2.6			200 mesh control screen					80
11	302						99.00		2.6			325 mesh control screen					95
13	F-110	.060		.03	.020		99.25	0.5	4.0				10	18	5	17	50
13	F-120	.060		.03	.02		99.20	0.55	3.6					.5	1.5	16	82
13	F-130	.070		.03	.02		99.15	0.60	3.4							.5	99.5
STEEL (stainless and low alloy)																	
6	302	18 Cr	8Ni					.50	3.1				25	25	25		25
6	302B	18 Cr	8Ni					.35	2.8	28			25	25	25		25
6	316	18 Cr	11Ni					.35	2.7	33			25	25	25		25
6	318	18 Cr	11Ni				1Cb	.45	2.7	29			25	25	25		25
6	410	12.5 Cr	.5Ni										25	25	25		25
6	4650			.2-1.0				.36	3.9	17			25	25	25		25
16	302B	18 Cr	8Ni	0.1	2.5	.8Mn		.35	2.6	28	5.5	3	20	25	14	13	25
16	316	17 Cr	11Ni	0.1	1.2	2.5Mo		.90	2.9	28	5.4	3	20	25	14	13	25
16		17 Cr	11Ni	0.1	2.5	2.5Mo		.35	2.3	32	5.7	3	20	25	14	13	25
16	4650		2Ni	0.5	0.3	0.3Mo		.50	3.4	20	5.4	3	20	25	14	13	25

(Hydrogen loss on stainless steel, max. in hydrogen, 30 min. at 2300 F)
(Green density on stainless steel, no lubricant, pressure 80,000 psi)

TIN																	
1							99.5Sn	.10	2.7			trace	.2	1.0	2.0		90
5							99.9Sn		3.9			nil	1.7	9.0	8.0	10	98
6							99.5Sn	.10	2.7			trace	.2	1.0	2.0		90
11	51						99.5Sn		3.0			90	50 mesh control screen				
11	101						99.5Sn		2.50			100 mesh control screen					95
11	102						99.5Sn		3.0			100 mesh control screen					85
11	103						99.5Sn		3.1			100 mesh control screen					95
11	105						99.3Sn		1.3			200 mesh control screen					98
11	124						99.5Sn		3.5			100 mesh control screen					75
11	201						99.5Sn		3.0			200 mesh control screen					95
11	301						99.5Sn		3.00			325 mesh control screen					98
TITANIUM ALLOYS																	
18		Titanium Hydride							0.97		2.56	trace	0.3	0.6	0.8	1.8	96.5
18							20.0Ti	80.0Co	1.44		4.60	2.3	4.3	12.3	13.9	17.1	50.1
18							60.0Ti	40.0Co									
18							80.0Ti	20.0Co									
18	421						30.0Ti	70.0Ni	2.17		5.58	1.2	2.7	4.6	5.7	9.0	76.8
18	492						50.0Ti	50.0Ni	2.05		4.00	0.7	5.2	12.3	15.3	24.5	42.0
18	427						70.0Ti	30.0Ni	2.23		3.68	0.2	0.8	2.6	5.2	11.7	79.5
ZIRCONIUM ALLOYS																	
18	361	Zirconium Hydride							1.48		4.00	trace	0.2	0.4	0.6	1.0	97.8
18	461						30.0Zr	70.0Ni	2.23		5.58	0.2	0.5	0.6	0.9	1.8	95.9
18	466						70.0Zr	30.0Ni	1.97		4.13	0.1	0.3	0.6	1.0	2.7	95.3
CHROMIUM ALLOYS																	
18	380						20.0Cr	80.0Ni	2.67	28	5.78	11.9	13.5	15.5	13.1	14.0	32.0
18							50.0Cr	50.0Ni	2.07		5.12	5.3	7.4	11.8	10.4	11.3	53.8
18	385						80.0Cr	20.0Ni	1.77		4.83	0.1	2.5	6.4	5.6	9.0	76.4
18							30.0Cr	70.0Co	1.75	42	5.28	4.9	18.6	19.1	14.7	14.2	28.5
18							70.0Cr	30.0Co	1.82		4.42[11]	0.2	1.0	1.9	2.2	3.4	91.3

[11] Compacted at 40,000 psi, 1% Sterotex added in excess.

* g/cc ** sec./50g sample † with 1% Stearate @ 60,000 psi

SMALL PARTS USERS OF

BRASS

CAN CUT COSTS

BY DESIGNING PARTS TO BE *PRESSED FROM BRASS POWDER*

The tens of millions of powder metallurgy brass parts in use today are evidence that alert engineers can design this proven material into many products which previously called for a brass casting, stamping, or machined part. In designing parts of brass—as in any other design problem—price is rarely the first factor to consider—but almost always the *second.* It's QUALITY you consider first. Will the part meet your requirements for strength, density, color, accuracy of size . . . meet these requirements uniformly by the tens of thousands or by the millions? Bound Brook, pioneer in powder metallurgy can answer your quality questions . . . then, if your requirements are for volume . . . can usually quote a price that means a substantial saving . . . and can make delivery, as promised, to keep your production line moving. For authoritative answers on your questions about powdered brass, bronze, or iron parts . . . or bronze or iron bearings . . . write or wire Bound Brook direct or telephone your nearby Bound Brook man.

BOUND BROOK

BOUND BROOK OIL-LESS BEARING CO., EST. 1883, BOUND BROOK, N. J.

Pioneer in

POWDER METALLURGY BEARINGS + PARTS

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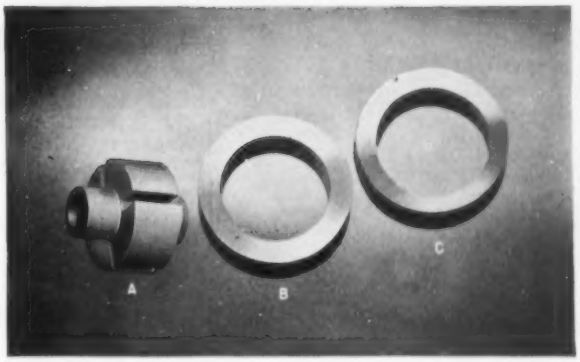
To facilitate use of this buyer's guide, **listings of companies advertising in this issue have been set in bold face type.** Refer to the Index of Advertisers, pages 143 and 144, for sources of more complete details about these companies' products.

72% SAVING

by switching to

NICKEL SILVER POWDER PARTS



CASE HISTORY | **No. 11**

The above three corrosion-resistant nickel silver powder parts — water pump components — represent a *cost saving of 72 per cent.* To achieve the same degree of dimensional accuracy and fine finish by the former production method involved costly machining of bar stock with a considerable scrap loss.

Coining of these nickel silver parts after sintering provides tolerances of .0005 in. on the length of rotor A and .0005 in. on the concentricity of liners B and C.

23 ADDITIONAL CASE HISTORIES AND DATA ON DESIGN, PROPERTIES AND PRODUCTION

HERE!

SEND FOR YOUR COPY

THE NEW JERSEY ZINC COMPANY
160 Front Street New York 38, N. Y.

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3rd annual

POWDER METALLURGY DIRECTORY

SECTION 2

PRODUCT SOURCES

Components Fabricators

BEARINGS
Copper or Iron Base

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

American Sinterings Div.
Engineered Plastics Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.

Brockway Pressed Metals, Inc.
Brockway, Pa.

Capitol Mfg. Corp.
22nd & Hervey
North Chicago, Ill.

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.

Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.

Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

Ferro Powdered Metals, Inc.
Salem, Ind.

Ford Motor Co.
Dearborn General Mfg. Div.
Plastics & Machining Plant
Dearborn, Mich.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.

Johnson Bronze Co.
500 S. Mill
New Castle, Pa.

Keystone Carbon Co.
State Street
St. Marys, Pa.

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Calif.

The Lux Clock Mfg. Co., Inc.
Waterbury, Conn.

Metal Powder Products, Inc.
Logan, O.

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

National Molded Products, Inc.
40-42 S. St. Marys
St. Marys, Pa.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Precision Metal Products Co.
Commerce St., Box 129
Ellwood City, Pa.

The Presmet Corp.
112 Harding
Worcester, Mass.

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

Symmco, Inc.
Sykesville, Pa.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

BEARINGS
Other types

American Sinterings Div.
Engineered Plastics Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn

Firth Sterling Inc.
3113 Forbes
Pittsburgh, Pa.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Clevland, O.

Symmco Inc.
Sykesville, Pa.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.
Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

CEMENTED CARBIDES
All types

Adamas Carbide Corp.
Kenilworth, N. J.
American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.
Firth Sterling, Inc.
3113 Forbes
Pittsburgh, Pa.
Sintercast Corp. of America
134 Woodworth
Yonkers, N. Y.
Welded Carbide Tool Co.
62 Colfax
Clifton, N. J.

CONTACT MATERIALS
Pure metals (platinum, silver, etc.)

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
Fansteel Metallurgical Corp.
North Chicago, Ill.
Gibson Electric Co.
8436 Frankstown
Pittsburgh, Pa.
Keystone Carbon Co.
State Street
St. Marys, Pa.
P. R. Mallory & Co., Inc.
3029 E. Washington
Indianapolis, Ind.
Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.
Speer Carbon Co.
Speer Resistor Div.
Theresia St.
St. Marys, Pa.
Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.
Superior Carbon Products
9115 George
Cleveland, O.

CONTACT MATERIALS
Tungsten copper, tungsten silver, etc.

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.
Fansteel Metallurgical Corp.
North Chicago, Ill.
Firth Sterling, Inc.
3113 Forbes
Pittsburgh, Pa.
Gibson Electric Co.
8436 Frankstown
Pittsburgh, Pa.
Keystone Carbon Co.
State Street
St. Marys, Pa.
P. R. Mallory & Co., Inc.
3029 E. Washington
Indianapolis, Ind.

continued next page

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can duplicate this part for

61% LESS

MACHINED PART — 18¢
POWDERMET* PART — 7¢

Don't cut parts—*Cut Costs!*
—with YALE Powdered Metal Parts

When it comes to keeping production costs down, American industry turns more and more to powder metallurgy. For here are tough, accurate parts completely ready for assembly...that not only do the job more cheaply, but often *better!*

With identical machined parts, most of the cost goes into the expensive machining operation. The price of *one* machined part will buy up to *six* of the same parts in powdered metal!

Close tolerances, excellent wearability, and controlled porosity are established Powdermet* virtues. Special properties—such as self-lubrication, or unusual electrical characteristics—can also be achieved. Alloys are available exceeding the tensile strength of mild steel.

The answer to your production problems may well be Powdermet* parts...and Yale & Towne. For Yale & Towne has the experience and know-how to serve you best in this rapidly-developing new field.

A qualified Yale & Towne engineer is available to discuss the advantages and limitations of powdered metal parts—*right in your own plant!* He will show you how powder metallurgy may cut costs in your production operations. There is no obligation for this engineering counsel.

TYPICAL PM PARTS

Filters	Gears
Bearings	Cams
Switch Parts	Keys
Wheels	Valves
Sprockets	Ratchets
Pawls	And *many more*

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The world's most famous key
...symbol of industrial leadership!

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MANUFACTURING COMPANY
PMP *Powdered Metal Products Division*
9335 Belmont Avenue • Franklin Park, Illinois

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Powdered Metal Products Division
9335 West Belmont Avenue
Franklin Park, Illinois

☐ Send Booklet ☐ Send information on PM parts for attached specifications or drawings.
☐ Have a Yale & Towne Powdered Metal engineer call on me.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

*TRADE-MARK

For additional information Circle No. 101 on the Reader Service Card

MH Chrome-Nickel Pre-Alloyed Powders

can give your compact, regardless of size —

- **Tensile strengths to 105,000 psi**
- **Sintered densities to 7.11**
- **% Elongation in 1 inch to 4.9%**
- **Rockwell hardness to B-98**

Yes, a 7.5% addition of Metal Hydrides' pre-alloyed chromium-nickel powder, plus 1% graphite to electrolytic iron powder can give your product these qualities. Check the chart below. See how easily MH chrome-nickel pre-alloyed powder can fit into your production picture, giving you volume production of high tensile, intricate parts at less cost:

	No Alloy		7.5% (20 Cr-80 Ni)		7.5% (30 Cr-70 Ni)		7.5% (80 Cr-20 Ni)	
	2012°F	2192°F	2012°F	2192°	2012°F	2192°F	2012°F	2192°F
Density, g/cc	7.05	7.12	7.02	7.11	6.95	7.10	6.74	6.83
Rockwell Hardness	B-78	B-78	B-71	B-90	B-91	B-90	B-80	B-98
Tensile Strength, psi	53000	68500	70200	83000	82700	100800	73400	105000
Elongation, % in 1"	4.2	4.0	4.9	3.4	2.7	4.6	1.8	2.2

Write for complete information now. No obligation of course.

MH

Metal Hydrides
INCORPORATED

20 CONGRESS ST., BEVERLY, MASS.

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Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.
Speer Carbon Co.
Speer Resistor Div.
Theresia Street
St. Marys, Pa.
Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.
Superior Carbon Products
9115 George
Cleveland, O.

CORES
High Frequency

Henry L. Crowley Co., Inc.
1 Central
West Orange, N. J.
General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.
Indar Corp.
2215 Alvord
Indianapolis, Ind.
(special)
Magnetic Core Corp.
2 Croton
Ossining, N. Y.
National Moldite Co.
1410 Chestnut
Hillside, N. J.
Pyroferric Co., Inc.
Pyroferric Bldg.
New York, N. Y.
Radio Cores, Inc.
9540 S. Tulley
Oak Lawn, Ill.
Speer Carbon Co.
Speer Resistor Div.
Theresia St.
St. Marys, Pa.
Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.
Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

CORES
Low Frequency

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.
Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.
Magnetic Core Corp.
2 Croton
Ossining, N. Y.
National Moldite Co.
1410 Chestnut
Hillside, N. J.
Pyroferric Co., Inc.
Pyroferric Bldg.
New York, N. Y.
Radio Cores, Inc.
9540 S. Tulley
Oak Lawn, Ill.
Speer Carbon Co.
Speer Resistor Div.
Theresia St.
St. Marys, Pa.
Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

ELECTRICAL COMPONENTS
Collector Rings

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Gibson Electric Co.
8436 Frankstown
Pittsburgh, Pa.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

Metal Powder Products, Inc.
Logan, O.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Superior Carbon Products
9115 George
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Frankin Park, Ill.

ELECTRICAL COMPONENTS
Commutator Segments

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Gibson Electric Co.
8436 Frankstown
Pittsburgh, Pa.

Keystone Carbon Co.
State Street
St. Marys, Pa.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

ELECTRICAL COMPONENTS
Pole Pieces

American Sinterings Div.
Engineered Plastics Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.

Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.

Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Calif.

Magnetic Core Corp.
2 Croton
Ossining, N. Y.

Merriman Bros., Inc.
185 Amory
Jamaica Plain
Boston, Mass.

Metal Powder Products, Inc.
Logan, O.

Michigan Powdered Metal Products, Co., Inc.
466 Cady
Northville, Mich.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Pow-Met Industries
1460 Cincinnati
Dayton, O.

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

ELECTRICAL COMPONENTS
Rotor Segments

American Sinterings Div.
Engineered Plastics, Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.

Detroit Sintered Metals, Inc.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Merriman Bros., Inc.
185 Amory
Jamaica Plain
Boston, Mass.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

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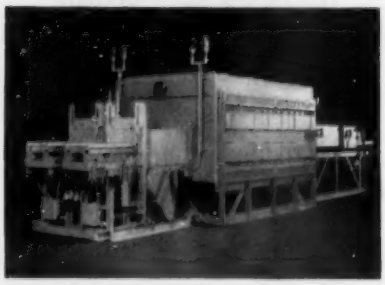
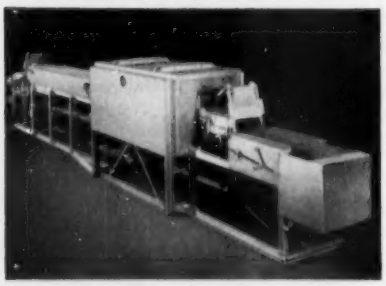
STREAMLINE YOUR PRODUCTION WITH MODERN

Harper ELECTRIC SINTERING FURNACES



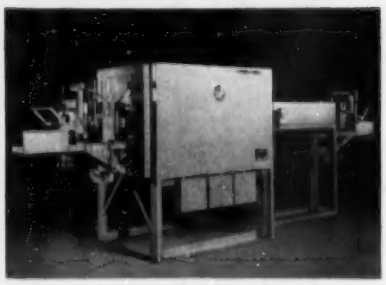
Mechanical or Hydraulic PUSHER TYPE FURNACE—Doubles Production in ½ the space

Twin muffles and pusher mechanisms provide double the production capacity, yet take only ½ the floor space required by two ordinary furnaces. Ideally suited for straight line conveyorized production with consequent savings in man hours. Independently controlled pushers provide a smooth flow of concentrated loads up to 600 pounds an hour on a continuous basis for long heating cycles. Several sizes for sintering and infiltrating.



CONTINUOUS MESH BELT CONVEYOR FURNACE

Continuous, large volume production possible by means of high power input. Alloy mesh belt with simplified take-up and speed-selection drive mechanism gives continuous trouble-free service. The greater production capacity of this furnace means important savings in valuable floor space and man power. Close temperature control assures product uniformity. In sizes to suit a wide variety of sintering requirements.



MANUAL PUSHER TYPE FURNACE

High power input provides high production capacity. This furnace is compact and very efficient, having the same basic features found in Harper mechanical or hydraulic pusher furnaces except that parts are charged and discharged manually. Loading and exit doors are smooth acting, providing good atmosphere retention. Hot zone provided with three zone power adjustments for required temperature uniformity. Several sizes for sintering and infiltrating.

Furnace Builders Harper *for over 30 Years*

HARPER
Electric Furnace Corp.
41 RIVER ST., BUFFALO 2, N. Y.

Visit Harper Booth No. 8
Metal Powder Show
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Hillburn, N. Y.
Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
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Detroit, Mich.
Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
General Metals Powder Co.
130 Elinor
Akron, O.
General Powdered Metal
Products Co., Inc.
523 West
Norwalk, Conn.
Metallic Friction Material Co.
5400 W. 130
Cleveland, O.
Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.
Powdercraft Corp.
746 Hayne
Spartanburg, S C.
(copper base)
The Presmet Corp.
112 Harding
Worcester, Mass.
(clutch shoe material)
Raybestos-Manhattan, Inc.
61 Willett
Passaic, N. J.
(industrial and automotive)
Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.
(carbon-graphite)
Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.
(bronze-molybdenum)
S. K. Wellman Co.
200 Egbert
Bedford, O.

MAGNETIC MATERIALS (soft)

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.
(iron-nickel)
Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.
(iron-nickel)
Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.
(iron nickel, iron silicon)
Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.
Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.
(iron nickel)
Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.
General Powered Metal
Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.
(iron nickel, iron silicon)

Indar Corp.
2215 Alvord
Indianapolis, Ind.
(iron nickel)

Keystone Carbon Co.
State St.
St. Marys, Pa.

Metal Powder Products, Inc.
Logan, O.
(iron nickel, iron silicon, high density iron)

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.
(iron)

The Presmet Corp.
112 Harding
Worcester, Mass.
(iron silicon)

Sintered Metals, Inc.
3390 Washington
Jamiaca Plain
Boston, Mass.
(iron nickel, iron silicon)

Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.

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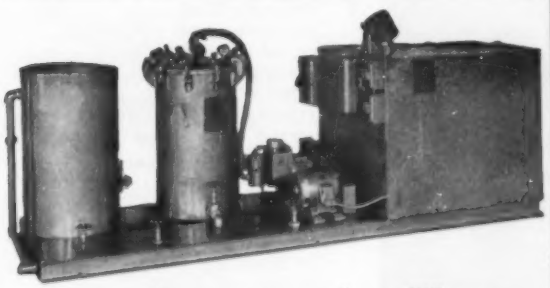


A Packaged Impregnating Plant

THE MOGULLIZING VACUUM PRESSURE-UNIT

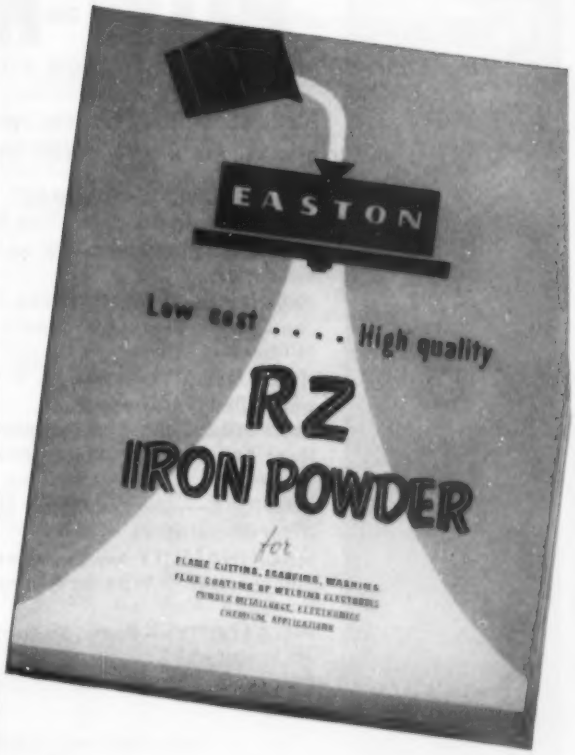
Model M-30

For low-cost, efficient impregnating of porous and leaking pressure castings, either ferrous or non-ferrous metals, use our MOGULLIZING Vacuum-Pressure System. The MOGULLIZER is made in all sizes from the small laboratory models of one cubic foot to the large industrial units with 100 cubic feet or more auto-claves (impregnating tanks). We obtain 29.5" or more of vacuum with this machine.

MOGUL Cast Seal is recommended with these units for impregnating all types of castings. No after-baking required.

Send us your problem and ask for booklet: "Mogul Cast Seal Impregnating Process"

METALLIZING COMPANY OF AMERICA
Dept. PMM
3520 W. Carroll Avenue • Chicago 24, Illinois
Circle No. 67 on the Reader Service Card



New answer to your metal powder problems

Having trouble getting the grade of powder you want at the price you want to pay?

Chances are you'll find the solution in Easton's low-cost, high-quality RZ iron powder.

Our new modern Easton plant is now in full production. We're working on grades suitable for flame-cutting, scarfing, washing, flux coating of welding electrodes, powder metallurgy, electronics, and chemical applications.

Write for this new free bulletin — it'll give you the complete story on this important new source of supply for metal powder.

EASTON
RZ

EASTON METAL POWDER CO., INC.
233 *Broadway, New York 7, N.Y.*
Circle No. 121 on the Reader Service Card

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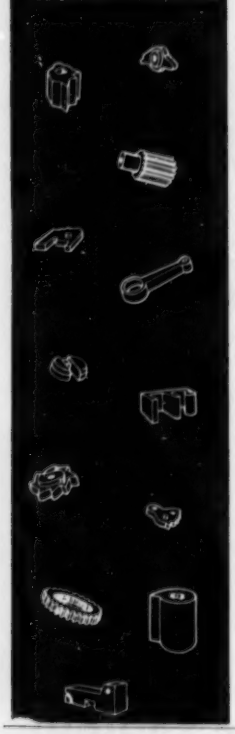
HD HIGH DENSITY HEAVY DUTY MECHANICAL PARTS



POW-MET

HIGH DENSITY IRON POWDER PARTS

With all Physical Properties Equal to or Exceeding The Physical Properties of Steel

HIGH TENSILE AND IMPACT STRENGTHS—Tensile Strength up to 200,000 P.S.I

SUPERLATIVE FINISH—8 to 15 Micro-Inches or Better

PRECISION DIMENSIONAL CONTROL—Exceptionally Close Tolerances Consistent Over Millions of Parts

HIGH DENSITY—Range 7.2 to 7.7 Grams per Cubic Centimeter

HEAT TREATMENT—Complete Facilities for Heat Treating or Copper Brazing, Where Required

DUCTILITY—Up to 25% Elongation where After-forming is required

MACHINABILITY — Excellent Non-burring Machinability Where After-machining is to be done

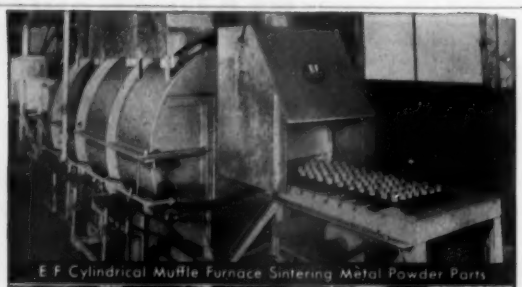
WELDABILITY—Parts Suitable for All Types of Welding

ANTI-CORROSION TREATMENT — When Desired

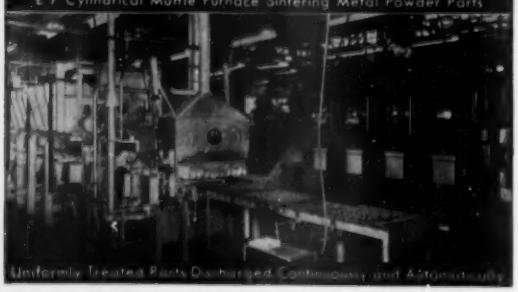
POW-MET INDUSTRIES INC.
1460 Cincinnati St. • HEmlock 1912
DAYTON 9, OHIO

EF

FURNACES *for* processing metal powder products



E F Cylindrical Muffle Furnace Sintering Metal Powder Parts



Uniformly Treated Parts Discharged Continuously and Automatically

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● EF furnaces are built in many sizes and types for sintering a wide variety of ferrous and non-ferrous pressed metal powder products — for bonding metal powder to strip, and other processes.

With our long experience and complete manufacturing facilities we are in position to build the size and type to fit *your* specific requirements.

Gas-Fired, Oil-Fired EF and Electric Furnaces
for any Process, Product or Production
THE ELECTRIC FURNACE CO.
WILSON ST. at PENNA. R. R. *Salem - Ohio*

Canadian Associates • CANEFCO LIMITED • Toronto 1, Canada
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MAGNETIC MATERIALS (hard)

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.

General Electric Co.
Carboloy Dept.
Edmore, Mich.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

Permag Corp.
214 Taaffe
Brooklyn, N. Y.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.

MISCELLANEOUS

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.
(molybdenum wire, rod, sheet, tungsten wire, rod, sheet, heavy metal)

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.
(porous bronze filters)

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
(bronze filters)

Eaton Mfg. Co.
9771 French
Detroit, Mich.
(carbides and cermets)

General Electric Co.
Carboloy Dept.
Edmore, Mich.
(thermally sensitive resistors)

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.
(filters)

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.
(magnets, electrical parts)

STRUCTURAL PARTS

Brass

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

American Sinterings Div.
Engineered Plastics, Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.

Capitol Mfg. Corp.
22nd & Hervey
North Chicago, Ill.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.

Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.

Keystone Carbon Co.
State Street
St. Marys, Pa.

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Calif.

The Lux Clock Mfg. Co., Inc.
Waterbury, Conn.

Merriman Bros., Inc.
185 Amory
Jamaica Plains
Boston, Mass.

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton. O.

National Molded Products, Inc.
40-42 S. St. Marys
St. Marys, Pa.

The Presmet Corp.
112 Harding
Worcester, Mass.

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Symmco, Inc.
Sykesville, Pa.

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.

STRUCTURAL PARTS

Copper Base

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

American Sinterings Div.
Engineered Plastics, Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.

Brockway Pressed Metals, Inc.
Brockway, Pa.

Capitol Mfg. Corp.
22nd & Hervey
North Chicago, Ill.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.

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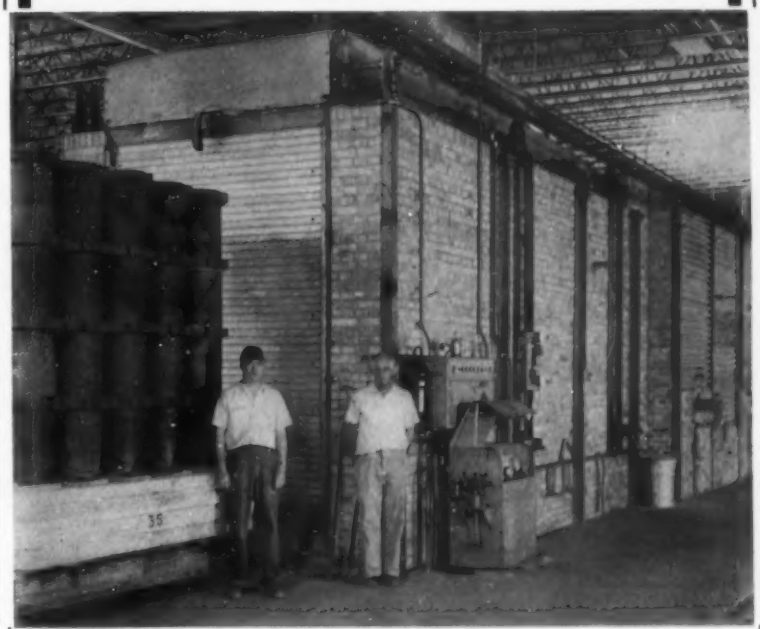
HOEGANAES
Sponge Iron Powder



Call in Your Powder Metallurgy Fabricator
For Design Consultation

MEMBER mpa METAL POWDER ASSOCIATION

EKSTRAND & THOLAND, INC.
441 LEXINGTON AVENUE
NEW YORK 17, NEW YORK

Sellers of Hoeganaes sponge iron powder.

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Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

Ferro Powdered Metals, Inc.
Salem, Ind.

Ford Motor Co.
Dearborn General Mfg. Div.
Plastics & Machining Plant
Dearborn, Mich.

General Powdered Metal
Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.

Johnson Bronze Co.
500 S. Mill
New Castle, Pa.

Keystone Carbon Co.
State Street
St. Marys, Pa.

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Calif.

Merriman Bros. Inc.
185 Amory
Jamaica Plain
Boston, Mass.

Metal Powder Products, Inc.
Logan, O.

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

National Molded Products, Inc.
40-42 S. St. Marys
St. Marys, Pa.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Precision Metal Products Co.
Commerce St., Box 129
Ellwood City, Pa.

The Presmet Corp.
112 Harding
Worcester, Mass.

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

Symmco, Inc.
Sykesville, Pa.

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Bemont
Franklin Park, Ill.

STRUCTURAL PARTS
Iron Base, controlled porosity

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

American Sinterings Div.
Engineered Plastics Inc.
Box 69
Watertown, Conn.

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.

Brockway Pressed Metals, Inc.
Brockway, Pa.

Capitol Mfg. Co.
22nd & Hervey
North Chicago, Ill.

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.

Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.

Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.

Ferro Powdered Metals, Inc.
Salem, Ind.

Ford Motor Co.
Dearborn General Mfg. Div.
Plastics & Machining Plant
Dearborn, Mich.

General Powdered Metal
Products Co., Inc.
523 West
Norwalk, Conn.

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.

Indar Corp.
2215 Alvord
Indianapolis, Ind.

International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.

Keystone Carbon Co.
State Street
St. Marys, Pa.

Kwikset Powdered Metal Products
516 E. Santa Ana
Anaheim, Calif.

The Lux Clock Mfg. Co., Inc.
Waterbury, Conn.

Merriman Bros., Inc.
185 Amory
Jamaica Plain
Boston, Mass.

Metal Powder Products, Inc.
Logan, O.

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.

Precision Metal Products Co.
Commerce St., Box 129
Ellwood City, Pa.

The Presmet Corp.
112 Harding
Worcester, Mass

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

Symmco, Inc.
Sykesville, Pa.

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

The Watertown Mfg. Co.
127 Echo Lake
Watertown, Conn.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
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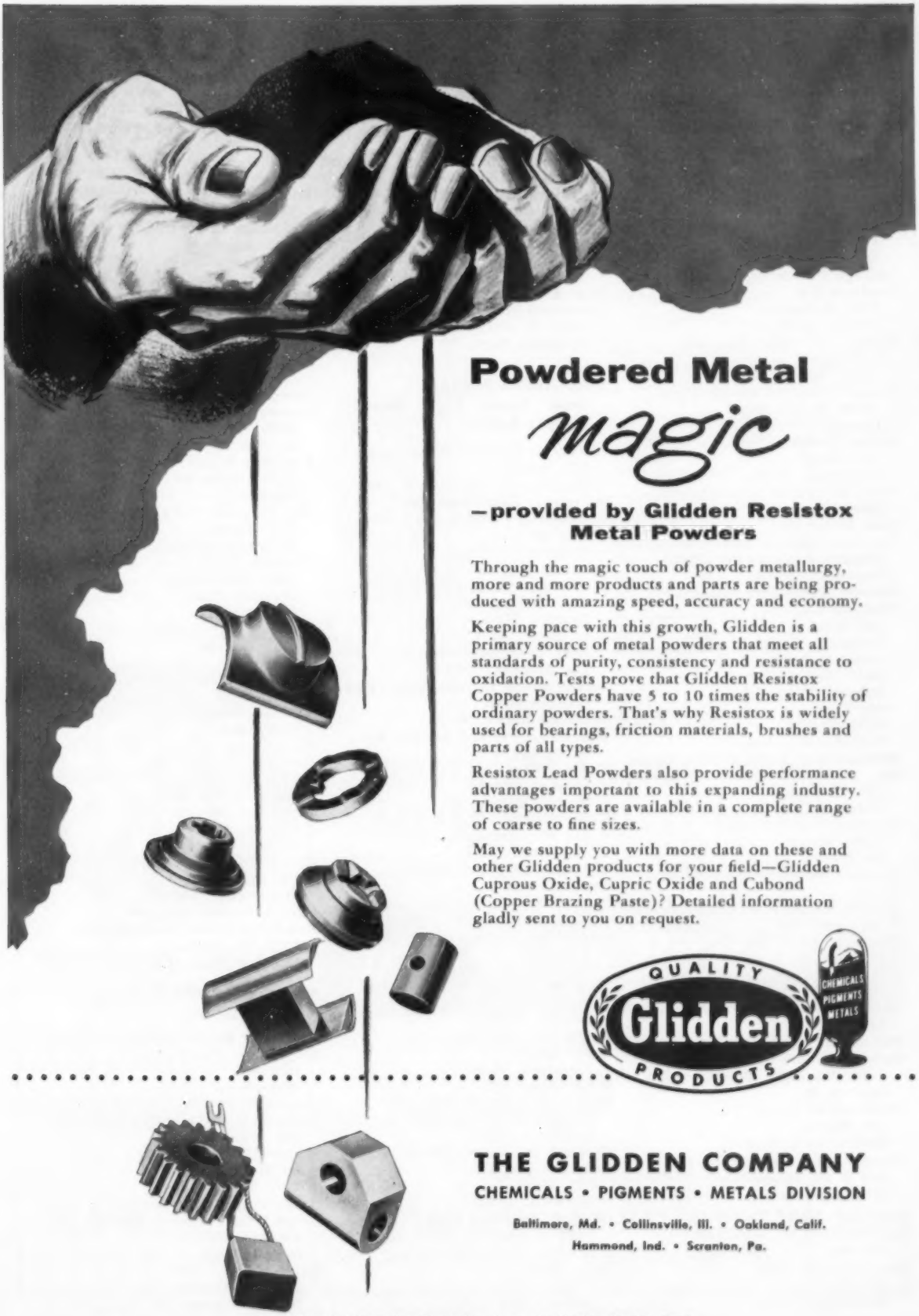
STRUCTURAL PARTS
Iron Base, infiltrated

American Electro Metal Corp.
320 Yonkers
Yonkers, N. Y.

American Sinterings Div.
Engineered Plastics, Inc.
Box 69
Watertown, Conn.

continued on page 86



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Bound Brook, N. J.
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North Chicago, Ill.
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9700 Waveland
Schiller Park, Ill.
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Detroit, Mich.
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Schiller Park, Ill.
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Indianapolis, Ind.
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Keystone Carbon Co.
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Reese Metal Products Corp.
537 Howard
Lancaster, Pa.
Sintered Metals, Inc.
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29 Foundry
Wakefield, Mass.
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Franklin Park, Ill.

STRUCTURAL PARTS
Iron Base, high density, copper free

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North Chicago, Ill.
Ceromet, Inc.
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Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.
Henry L. Crowley & Co., Inc.
1 Central
West Orange, N. J.
Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.
Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
Ford Motor Co.
Dearborn General Mfg. Div.
Plastics & Machining Plant
Dearborn, Mich.
General Powdered Metal Products Co., Inc.
523 West
Norwalk, Conn.
General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.
Indar Corp.
2215 Alvord
Indianapolis, Ind.
International Powder Metallurgy Co.
439 W. Main
Ridgway, Pa.
Keystone Carbon Co.
State Street
St. Marys, Pa.
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Anaheim, Calif.
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466 Cady
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3390 Washington
Jamaica Plain
Boston, Mass.
Superior Carbon Products
9115 George
Cleveland, O.
Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.
The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.
Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.
The Watertown Mfg. Co.
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Watertown, Conn.
Yale & Towne Mfg. Co.
Powdered Metal Products Div.
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Spartanburg, S. C.

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Worcester, Mass.

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537 Howard
Lancaster, Pa.

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.

Superior Carbon Products
9115 George
Cleveland, O.

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.

The United States Graphite Co.
Div. The Wickes Corp.
1621 Holland
Saginaw, Mich.

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
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Franklin Park, Ill.

STRUCTURAL PARTS

Miscellaneous

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Yonkers, N. Y.
(filters)

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continued next page

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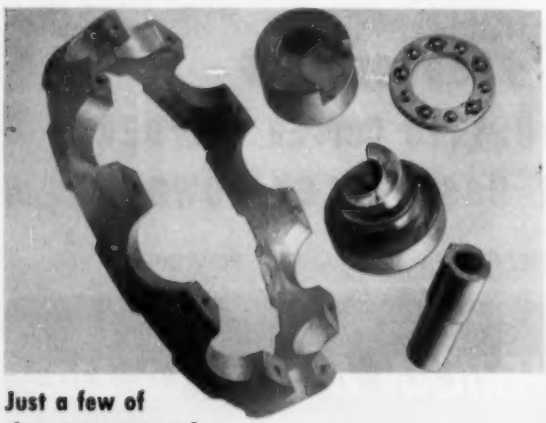

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assure

INCREASED GREEN DENSITY OF COMPACT
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Continental Industrial Engineers, Inc.
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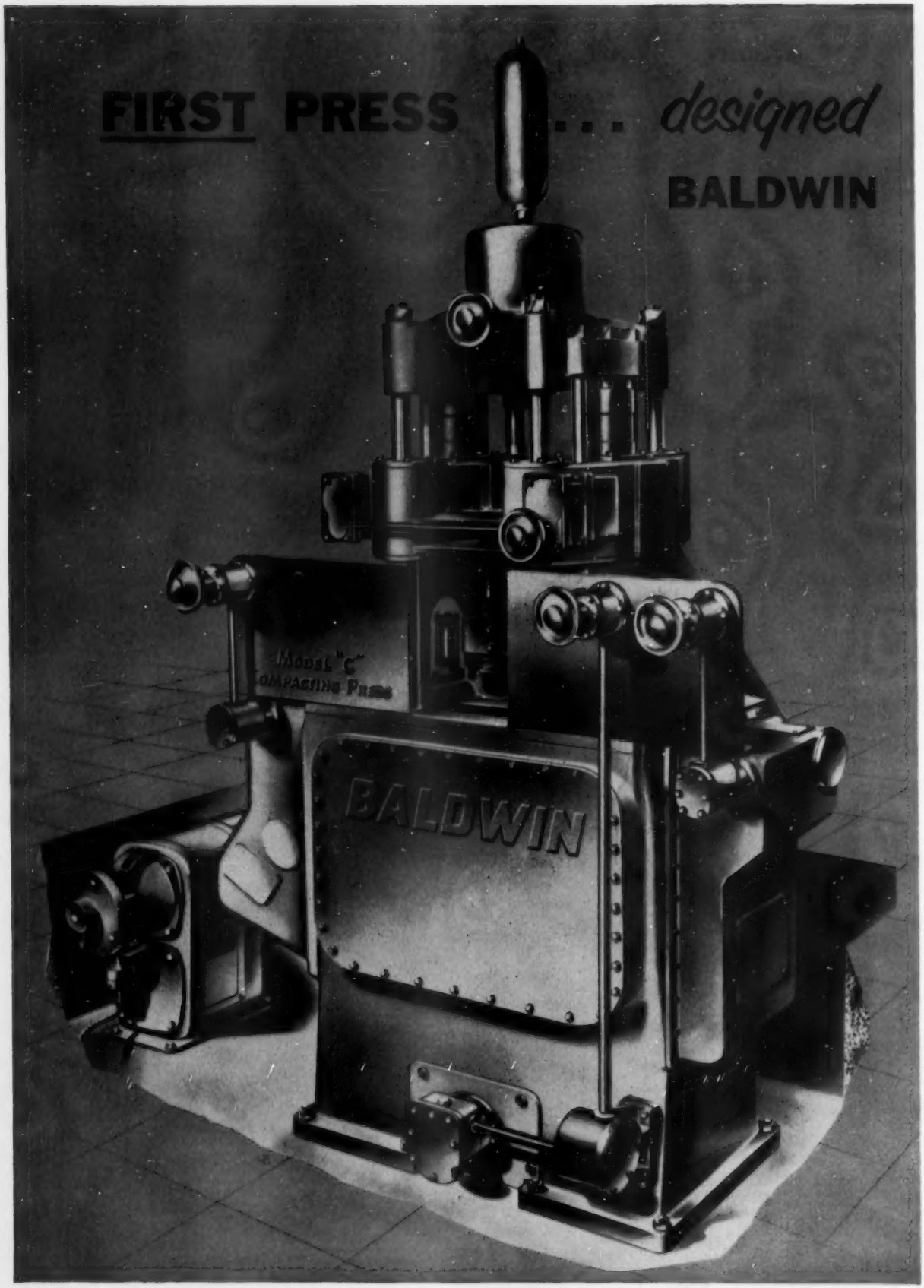
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The entire press mechanism, including a 20-hp motor, is completely enclosed and sealed to prevent entrance of abrasive materials, making it suitable for compacting powdered metal.

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Accurate pressure is assured by a hydraulic head whose ram supplies opposing pressure for the upper punch. Thus, if compressing pressure exceeds the hydraulic accumulator setting, the upper punch "gives" to and is held within the limit of the setting. This assures uniform densities of compacts, prevents overloading and prolongs the life of tools and press.

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This press uses an air-operated shuttle type feeder which moves from under a stationary hopper to a position over the die. The shuttle is supported on guide rods with a spring loaded cutoff ring to prevent loss of material. The depth of fill and the stroke of the bottom punch are adjusted by two separate handwheels, eliminating shimming the bottom punch to bring it flush with the top of the die. The relative position of the core rod to the die is also adjustable to aid in controlling the fill when making counterbored parts.

AUTOMATIC LUBRICATION

The lubricating system is equipped with a motor driven gear type lubrication pump, a filter, and a pressure switch. The main drive motor cannot be operated unless there is oil pressure in the lube system. Should the oil pressure drop below the pressure switch setting the main drive motor will stop.

CONTROLS PERMIT FIVE CYCLING VARIATIONS

1. Continuous run.
2. Press will stop at any pre-determined point in its cycle, dwell up to 15 seconds (adjustable) and start automatically.
3. Single stroke (stops at pre-determined point in cycle and starts only when start button is pushed).
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5. Press can be inched through its cycle.

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Booth 32

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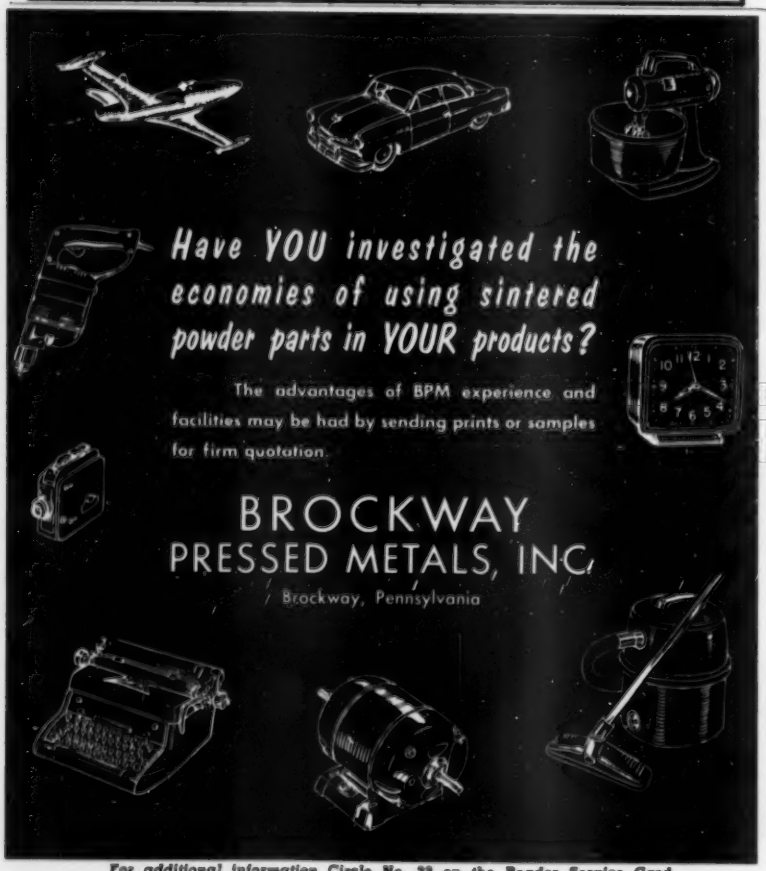
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continued next page

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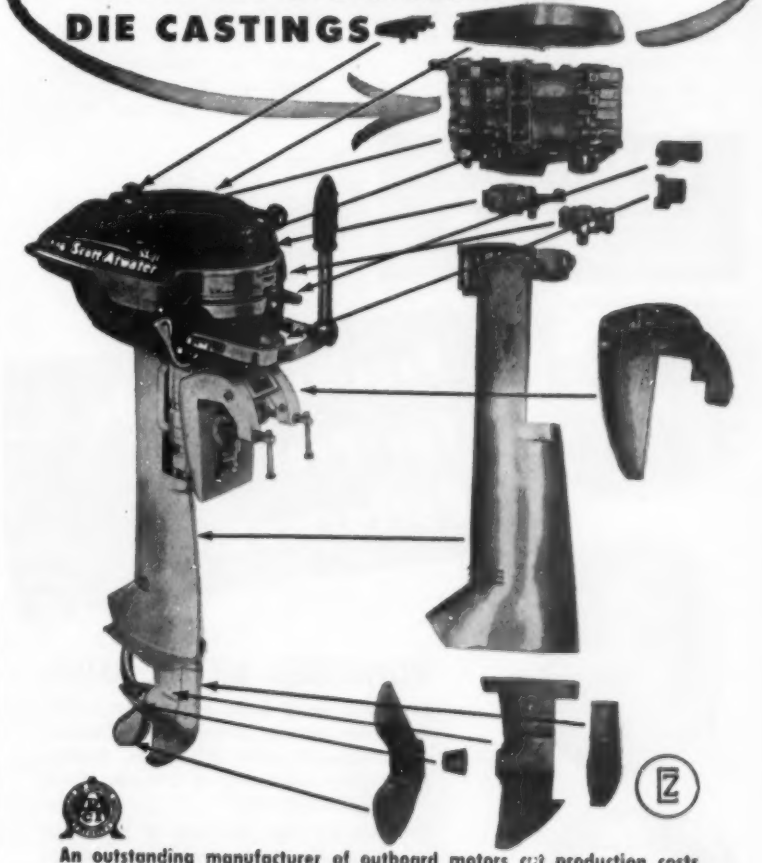

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continued on page 96

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A FULL 360° COLD TWIST applied to typical parts, demonstrates an important fact to designers and buyers. It shows that these high density parts, made from HVA electrolytic iron powder, can equal — or even exceed — the properties of wrought materials of the same composition. And it means that a whole new range of parts, once obtainable only by costly machining of wrought stock, can be made economically from iron powder.

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Material: HVA electrolytic iron powder (3.4 g/cm³) + 2% copper
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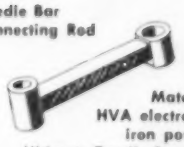

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continued on page 135

PMM

Finishing Section

SURFACE FINISHING

Most precision metal molded parts receive some type of surface finish such as plating, organic coating, anodic coating, or chemical coating. This section includes information on the methods, processes and equipment used in these surface treatments.

A Section Devoted to Specialized Finishing of

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Two New Ways To Fasten Shell Mold Halves

Here, a mold assembler at Detroit's City Pattern Foundry and Machine Company easily fastens together halves of a shell mold for a casting for a welding torch holder with U-type Speed Clips. The company reports a 75 percent reduction in materials handling time over former methods.

For Small Molds ←

SINCE its introduction in this country in 1947, the shell molding process, alternately known as the Croning process, has proved itself a unique means of producing high quality castings in a wide variety of metals.

As the name implies, "shell molding" is a technique for making castings in a mold that is merely a shell of sand varying in thickness from ⅛ to ⅜ of an inch. The sand grains composing the mold are bonded together with thermosetting resins such as the phenolics, the alkyds and the polyesters.

After forming, the two halves of a shell mold are aligned by means of alignment pins and sockets. Once assembled, they must be held together tightly to permit their handling during the back-up operation. Obviously, there must not be any swell or spread at the parting line in order that all dirt be excluded.

To assure proper mold closure, a number of assembly techniques have been developed. "C" clamps, thermosetting and air drying adhesives, and bonding tapes have been given considerable attention in foundries where the shell molding process is employed.

A new and effective technique for securing shell mold halves together is the use of special U-type Speed Clips, developed by Tinnerman Products, Inc., of Cleveland.

Requiring about as much effort and skill as it does to attach a paper clip to a letter, the U-type fastener, made of high quality spring steel, is snapped easily and quickly by hand over mold flanges to lock them together under live spring tension.

Vaughn Reed, Jr., vice president of Detroit's City Pattern Foundry and Machine

continued next page

Here, a large shell mold is being assembled with rivets and Push-On type Speed Nuts at Mechanical Handling Systems, Inc., Detroit pioneer in completely automatic manufacture of shell molds. Once rivets are inserted through holes formed or drilled in mold, the Push-Ons are pressed over the rivet by hand for firm attachment.

Either U-Clips Or Push-Through Fasteners Can Be Used

Fasteners For Shell Molds — cont.

Company, reports that his molders have cut their materials handling and assembly time more than 75 percent over former methods since the company began to use this type of fastener in their shell molding operations. Now just one man, according to Reed, can assemble as many shell molds in a single day by using the U-type fasteners as he did previously in four days.

Moreover, the use of these clips in shell mold assembly eliminates the necessity for drilling rivet holes in the smaller, finished shell molds. Drilling is not time-consuming, but it results in considerable expense owing to the rapid depreciation of drills caused by the highly abrasive sand-resin composition of shell molds.

Of course, provisions for rivet holes can be made in the original mold pattern, but this procedure steps up the cost of the molds. The method also increases materials handling time, since the nodule left by the pattern must be removed to expose the rivet hole.

For securing larger, heavier shell mold halves together — shells which because of their bulk must be assembled with rivets or bolts inserted through the complete mold at various points, spring steel push-on type Speed Nuts are also available.

The operation is equally simple. These unique fasteners, which provide a positive "bite" that grips securely on rivets, nails, tubing and other unthreaded parts, are pushed by hand over the assembly rivets once they have been inserted through aligned holes in the closed mold. Pushed flush against the shell, the fastener locks itself in position for a positive attachment.

For especially rapid mold assembly, these push-on nuts are provided in a tandem strip. A partial shear between each fastener in the strip permits mold assemblers to easily break the strips free from each attached nut and move quickly to the next location without lost motion.

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Lea Copper-Glo

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The Lea-Ronal Bright Copper Process* is the answer to the plater's prayers, particularly when nickel is still short in supply. Lea Copper-Glo, used with this process, makes it practicable to chrome plate prefinished steel and die-castings over thinner layers of nickel than needed with other processes. With this copper plating you can cut your bright nickel deposit to a minimum because the nickel does not have to be used to build 'brightness.' The copper deposit obtained from the Lea-Ronal Process is brilliant in itself. Thus, you will save by being able to use heavier copper and lighter nickel.

The user of Lea-Ronal Bright Copper Process enjoys numerous advantages, as for example:

OPERATING

- Brilliant ductile deposits
- High current density with 100% efficiency
- Exceptional throwing power
- Operations with or without free-rinsing wetting agents depending upon specific production conditions
- Direct, interrupted, or periodic reverse current

COST SAVINGS

- High speed operations reduce tank plating time (Hull cell bright current density range 0 to 60 amp/ft.^{2})
- Reduces rejects whether followed by bright nickel plate or otherwise
- Reduces consumption of copper cyanide because of excellent anode corrosion

The Lea-Ronal Bright Copper Process, using Lea Copper-Glo, can be fitted into your plant operating cycle. Most cyanide copper baths can be converted to obtain these advantages.

*Patents Pending

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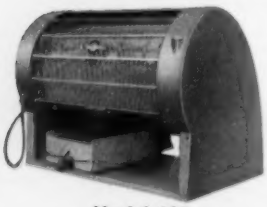
And, the time-saving Grav-i-Flo process for finishing and deburring cuts direct labor costs too. Hundreds of companies are getting better finishing and deburring results, faster and cheaper. If you haven't checked these advantages to your competitive position, do so today! Invite Grav-i-Flo to make recommendations.

Grav-i-Flo offers complete equipment, accessories and supplies for all your tumbling needs!



Model 66", two compartments

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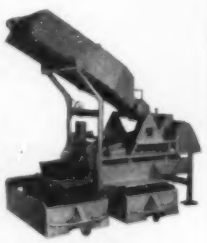

Occupies less floor space. Separates parts quickly without impingements. Grades 3 sizes of chips simultaneously.

Other Grav-i-Flo accessories include tubular yoke hoist pans, chip pans, wash-out doors, screens, chip bins, unloading boots, dip tanks.

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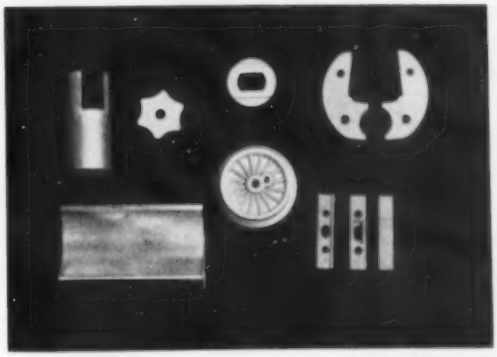
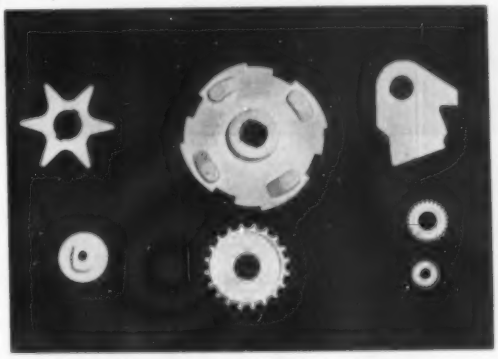
If powdered iron parts need protective surface treatment . . .



1. Protection of low carbon material against rust or heat is provided for indoor exposure, or . . .



2. Protection against wear or abrasion is provided on high carbon materials.

How To Make Iron Powder Components Resistant To Rust And Wear

BY RICHARD P. SEELIG, Executive Vice President, Chromalloy Corporation of New York.

POROSITY in powder metallurgy has many advantages and performs useful functions. However, it is a serious draw-back when it comes to finishing operations. Several methods have been proposed to prevent plating solutions from getting into the pores, or to remove the salts once they have infiltrated the voids. None of these methods appears to be entirely satisfactory.

A surface treatment which utilizes a reactive gas rather than a liquid electrolyte could be expected to avoid these difficulties. This idea has been translated into practice by Chromalloy Corp. through its chromizing process.

This method involves a reaction between a chromium-rich gas and the ferrous surface followed by diffusion. Depending upon the composition of the ferrous sintered metal (the method does not work on brass or bronze) and the type of treatment selected, two different results can be achieved. This applies not only to sinterings, but also to forgings, castings and machined parts:

1. On low-carbon material (straight sintered iron, 1010 steel, etc.) a chromium-iron alloy layer is formed which is rust resistant and possesses a considerable amount of ductility. This is called the Chromalloy case.

2. On high-carbon material (sintered iron-graphite mixtures, 1095 steel, etc.) a chromium carbide layer is formed which is extremely hard and abrasion resistant. This is called the Chromacarb case.

In practice this process is carried out by stacking the parts in a metal powder mixture. An energizer produces

continued next page

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- **ON COPPER** . . . Iridite brightens copper, keeps it tarnish-free; also lets you drastically cut the cost of copper-chrome plating by reducing the need for buffing.
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the chromizing gas and an inert material prevents the metal powder from sintering. Work and powder are enclosed in a tightly sealed retort and heated in a furnace. The temperature used may vary from 1500 to 2200F, depending upon desired results, composition of alloy and geometry of parts An atmosphere is used to prevent oxidation of the work as well as the powdered compound.

Some of the features of the process are:

Unlimited throwing power including some penetration into pores;

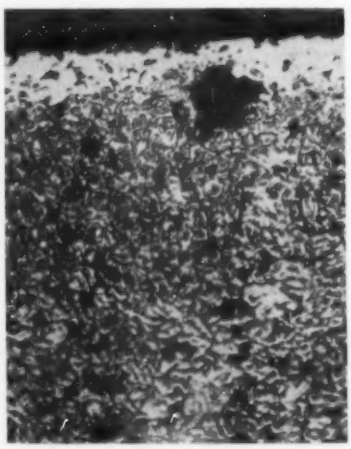
No blind spots;

Low cost;

No edge build-up;

Intimate metallurgical bond which cannot peel.

The Chromalloy case is applied to sinterings where rust and heat resistance is needed. Figure 1 shows powdered metal parts processed in this manner. These parts will retain their attractive silver



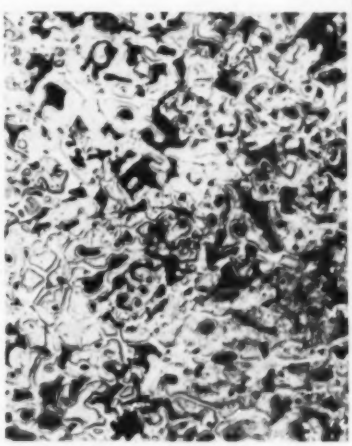
3. Photomicrograph (X100) of the Chromalloy case on an iron sintering of considerable porosity. Thickness of zone entirely diffused with chromium (Cr content above 13%), .0025". Note bridging of pores and some densification of case . This is representative of an average treatment on a sintered part.

grey finish without tarnishing or rusting in indoor exposure. For outdoor exposure where rain water may penetrate the pores and come in contact with unprotected metal inside, oil or other impregnation after Chromalloying or the use of infiltrated parts is recommended.

This process is not intended to give salt spray resistance to sinterings. Straight chromium-iron alloys are not highly salt-spray resistant. The uneven surface of powder parts caused by the pores and irregular particles unfavorable for corrosive conditions.

The Chromocarb case is applied to sinterings where wear and abrasion resistance are desired. The surface becomes harder than by any other surface hardening method, including carburizing, nitriding, cyaniding, etc. As a matter of fact, the thin skin formed on the exposed surfaces is almost as hard as sintered tungsten carbided. Parts processed by this technique are shown in Figure 2.

In applications where the loads on the surface are con-



4. Photomicrograph (X200) showing the structure of the sintering just below the completely diffused case. Note penetration of chromium along grain boundaries and particle surfaces across virtually entire field. Traces of Cr are still visible .015" below primary case.

Roto-Finish machines equipped with push-button controls and automatic timers, will shut themselves off automatically after being manually started and the timer set for the desired timing cycle. Thus with the automatic timer, machines can be started and timed to maintain a continuous production cycle that eliminates what is often the cause of a serious bottleneck. Ask your secretary to ship us two finished and several unfinished samples, marked for the attention of the Roto-Finish Processing Laboratories.

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3. Roto-Finish is the originator of modern precision barrel finishing and because of long experience can eliminate for you the costly trial and error purchase of machines.

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CUT TIME COSTS
Luster-on is applied in one quick cold dip, manually or automatically, usually saving ⅔ of the processing time of flash copper, nickel and chrome work. You know time costs money. Save both with Luster-on.

CUT POWER COSTS
You save on power used and rectifier and generator equipment required because zinc plate and Luster-on need no heavy power to plate compared to copper, nickel and chrome.

That's the 1-2-3 of it. While you save money with Luster-on you still can be *sure* of a uniform, corrosion-resistant, brilliant finish.

And if a bright scratch-free surface is important, you should investigate Luster-on Zinc-Chrome.

Start now TO SAVE MONEY WITH LUSTER-ON — the first in the field, and still the leader.

Write for free data sheets and send a part for free processing.

L-11

THE Chemical CORPORATION
66 Waltham Ave., Springfield 9, Mass.

Circle No. 107 on the Reader Service Card

siderable, a subsequent hardening operation is recommended. This does not affect the characteristics of the case in any way because its hardness is inherent and is neither increased nor impaired by heat treatment. However, a hardened core or matrix provides better support for the case under heavy stresses.

The physical properties of sintered iron are improved by Chromalloying (see Table 1). This is an incidental, but important and, perhaps, unexpected advantage. The simultaneous increase in tensile strength and elongation is a particularly desirable feature. An analysis of these data shows that the tensile strength is raised 28 percent and 53 percent respectively by treatments A and B. The average improvement in elongation amounts to 83 percent.

One might expect that these effects are a result of additional sintering at the chromizing temperature. However, this temperature is usually much lower than most commercial sintering operations. Then, the final properties are the same regardless whether the parts were processed in the green or sintered condition.

Finally, there is no shrinkage as a result of chromizing. On the contrary, there is a slight growth depending upon the size, shape and composition of the sintering. This volume change is readily reproducible and can be allowed for in the die if the tolerances are very close.

From this brief description it can be seen that the process provides a combination of rust protection, wear proofing and strengthening. Its applications in the field of powder metallurgy are bound to be manifold: sprockets, pawls, knobs, pole pieces, garbage disposal cutters, and parts for business machines, automobiles, pumps, tools, etc. are just a few of the many possibilities.

Although some of the advantages listed are unique to powder metallurgy applications, it should be emphasized that this chromizing process is also used on iron and steel parts made by other precision molding methods.

TABLE I

Test Specimens

Standard ASTM flat tensile bars for metal powder sinterings.
Type MH-100 iron powder plus 0.5% stearate as lubricant.
Pressed at 30 tsi.
Sintered at 2050 F for 45 min. in hydrogen
Sintered weight 24.7 gr. average.

Test Results

Condition	Chromalloy Treatment	Tensile Strength psi.	Elongation %
Pressed and sintered	—	17,800	6
Pressed only (green)	A	22,800	11
Pressed and sintered	A	22,750	11
Pressed only (green)	B	27,000	11.3
Pressed and sintered	B	27,450	11

These data were obtained at the laboratory of Lionel Corp., Irvington, N. J.

ASTE MEETS; MANY SESSIONS ON PRECISION FORMING

Many sessions of special interest to designers, buyers and producers of precision metal castings and powdered metal parts are scheduled for the 22nd annual meeting of the American Society of Tool Engineers this month.

The meetings will be held in conjunction with the 1954 ASTE Industrial Exposition, April 26-30, in Philadelphia.

Listed among the five days of techncial and production sessions are the following topics: New Techniques and Possibilities for Castings; How to Prepare for and Secure Superior Metal Surfaces; Improved Design and Dimensional Control for Investment Casting;

Also, What the Tool Engineer Needs to Know About Powder Metallurgy; What's New and Economical with Surface Cleaning; New Concepts in Abrbasive-Belt Grinding; and many topics relating to tooling, machining and ininspection.

Speaking at the 22nd annual banquet of ASTE will be Dr. Henry T. Heald, chancellor of New York University. Most sessions will be held in the Philadelphia Convention Center, but several are scheduled for the Bellevue-Stratford Hotel.

Officers for the 1953-54 term ASTE are Roger Waindle, president; Joseph P. Crosby, first vice president; Dr. Harry B. Osborn, Jr., second vice president; Howard C. McMillen, third vice president; Raymond C. W. Peterson, secretary; Harold E. Collins, treasurer; Wayne Ewing, assistant secretary-treasurer; Harry E. Conrad, executive secretary; and Allen Ray Putnam, assistant executive secretary.

Nearly 500 exhibitors will display tools, equipment, materials and services at the exposition held in conjunction with the meetings.

Barrel finishing boosts die maker's production 5000%

This almost unbelievable production increase was made by Callahan Can Machine Co., Inc., makers of bottle cap dies, when they switched to the HONITE Barrel Finishing Method. Too, per-unit labor costs for finishing were cut by a phenomenal 99.8% !

Dies are used to stamp out painted bottle caps. The problem was to remove sharp edges so that paint on the cap flanks would not be scratched. Former method of hand stoning each die resulted in low production with many rejects because hand stoning did not effectively round off the edges.

A HONITE barrel finishing machine, using SUPER-HONITE chips and the recommended HONITE compound was installed. Production immediately jumped to several hundred pieces per day.

Dies came out perfectly uniform, quality was improved and the reject problem was eliminated completely!

METAL FINISH, INC., Newark, N.J., is the HONITE distributor servicing the Callahan Can Machine Co. Your HONITE distributor can help you increase production and cut costs, too. Call him today!

Honite BRAND

MINNESOTA MINING & MFG. CO., Dept. PM-44, St. Paul 6, Minn.

I'd like to get more facts about HONITE Service.

☐ Send me free copy of "3M Barrel Finishing" Manual
☐ I'd like to talk with a HONITE Sales Engineer

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COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

Type of product to be finished.....

Made in U.S.A. by Minnesota Mining and Mfg. Co., St. Paul 6, Minn.-also makers of "Scotch" Brand Pressure-Sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N.Y. In Canada: London, Ont., Can.

3M

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● DISCS cut fast...on the FASTCUT Pad 85 Assembly

● CUT SHEETS fit your air or electric vibrating sander

● FOLD it like paper...TEAR it like cloth

NEW SAND SCREEN: Use both sides...do from 7 to 15 times the work!

TRADE MARK

SAND SCREEN by CARBORUNDUM is the new, open-mesh abrasive cloth for sanding and finishing that lets the removed material flow right through...instead of loading and glazing, as conventional abrasive paper and cloth do.

LASTS 7 TO 15 TIMES LONGER

Because it resists loading, and because you use *both sides*, SAND SCREEN sticks to its cutting job as much as 7 to 15 times longer than conventional abrasives. Both sides are uniformly coated with hard, sharp CARBORUNDUM® Brand Silicon Carbide abrasive grain for fast, easy sanding on metals, wood, paint undercoats and sealers.

USE IT WET OR DRY...BY HAND OR MACHINE

Use SAND SCREEN the same way you use your present paper or cloth—wet or dry, by hand or machine. For hand sanding, full 9" x 11" sheets fold like paper, tear like cloth to any width you desire. Cut sheets fit your oscillating or vibrating sanders. Discs give best results when used wet with CARBORUNDUM's FASTCUT Pad 85 Assembly. Ordinarily, no adhesive is needed when sanding flats or slight contours...the surface of the FASTCUT Pad holds the disc in place. Full sheets, cut sheets and discs come in 180 and finer grit sizes.

WHERE WOULD YOU LIKE TO USE SAND SCREEN?

We will work with you to help you take full advantage of SAND SCREEN's many advantages and cost-cutting features. Just tell us what operations you would like to test it on. Call your CARBORUNDUM Distributor or Salesman (listed under "Abrasives" or "Grinding Wheels" in the yellow pages). Or, if you prefer, write to us. Send the coupon for a sample and full details, anyway!

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THE CARBORUNDUM COMPANY, Dept. PM 82-46
Niagara Falls, New York

Rush folder about new SAND SCREEN.

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Continually putting MORE SENSE in your ABRASIVE DOLLAR

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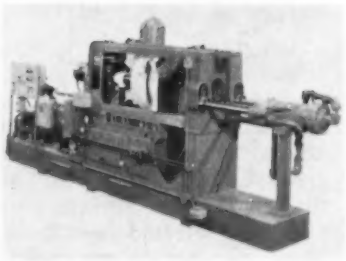
REGISTERED TRADE MARK

82-46

For additional information Circle No. 106 on the Reader Service Card

PRECISION METAL MOLDING

New Products ... the Reader Service Cards will bring full details



200 TON DIE CASTING MACHINE

. . . features controlled venting

The new HP-1-C die casting machine with a positive toggle clamping pressure of 200 tons features a central die height adjusting screw to allow dies to be set so that a fraction of a thousandth of an inch, at full clamp, opening will be secured. This allows full use of the maximum clamping pressure of the machine and at the same time provides for controlled venting

The machine is designed to cast up to 4⅞ pounds of aluminum, or proportionate weights of magnesium or brass. Dies up to 25″ wide by 22″ high can be accomodated. The machine is readily converted to the use of zinc.

According to company announcement, additional production of the HP-1-C machines makes possible updating of deliveries from Jan. 1955 to July, August and September 1954.

Lester-Phoenix, Inc.

For more information circle No. 196 on the Reader Service Card

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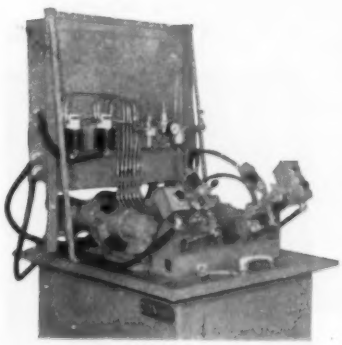

RIGHT LEFT HAND DRILLING

. . . done simultaneously

A new machine which drills right-hand and left-hand parts simultaneously has recently been announced.

The machine incorporates four automatic drilling units and can be used for either drilling or tapping or both.

In operation, the operator loads one each of right and left hand parts, then depresses the start-cycle buttons with both hands, whereupon the work is automatically clamped, drilled, unclamped and ejected.

Govro-Nelson Co.

For more information circle No. 197 on the Reader Service Card

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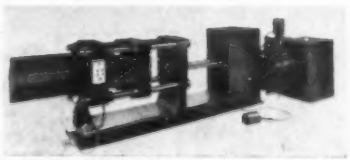

DIE CASTING MACHINE

. . . for high speed casting

A new model HD-303 cold chamber die casting machine is particularly adapted to casting aluminum alloys at high speed from either single or multiple cavity dies. Magnesium and brass are also readily cast with the cold chamber type of machine and zinc; lead and tin may also be handled after conversion to a hot chamber operation.

The conversion to the hot chamber may be made with a minimum of delay. Up to 300 complete casting cycles per hour may be obtained with the model HD-303 according to the manufacturer.

Machine movement and injection are both operated by a high pressure oil hydraulic system. Pressures up to 11,800 psi are used on the molten

metal as it solidifies. All controls are positioned to afford the operator easy, high speed operation.

Other features include tiebars that pull back giving full access to the platens which are open on all sides for easy die change; safety device to prevent metal injection before dies are locked under 300-tons pressure; and an arrangement which allows cores to be pulled in all directions, manually, hydraulically or mechanically.

The die clamping mechanism of the HD-303 has also come in for special attention. Dies are closed and held by knuckle joint design. The compound toggle has maximum of compression-bearing area and tiebars are pre-stressed when dies are closed to withstand metal injection pressure of 10,000 pounds per square inch over a die projected area of 75 square inches.

All piping and fittings on the hydraulic system power unit are high pressure steel and welded at the joints with flange connections to valve and pump. The motor is 15 h. p., 220 volt, 3-phase, push button control.

Harvill Mfg. Co.
For more information circle No. 198 on the Reader Service Card

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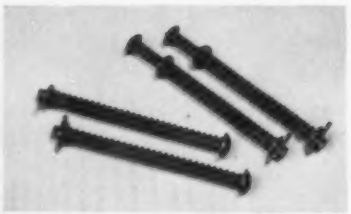
STANDARD EJECTOR PINS . . . . . for shell molding

Added savings can now be realized in shell molding through the use of standardized ejector pins. A pin has been developed which meets the needs of shell molding and is a standardized product so that transfer from one set-up to another, as well as simple, low cost replacement is now possible.

The pins are ⅜" diam. and



at present are available in lengths of 6" and 7½". The pin embodies a mushroom head design and also incorporates a negative angle under the head to give a positive seal to prevent the investment material from seeping under the head during molding.

Lengths are held to close tolerances to insure uniform ejection and prevent distortion or damage to the molded shells. All pins are heat treated to reduce wear and give longer life. Springs are of specially selected heat-treated stock to operate at molding temperatures without losing temper.

Detroit Mold Engineering Co.
For more information circle No. 199 on the Reader Service Card

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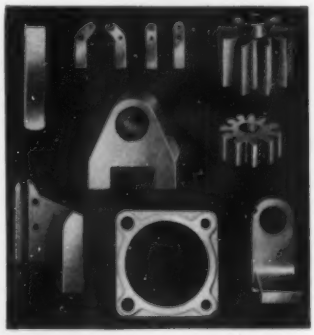
STAINLESS STEEL POWDER . . . of 18-8 low carbon type



A new stainless steel metal powder is now being marketed under the trade name of Stain-Alloy. According to the manufacturer, this powder can be used in all normal powder metallurgical applications such as structural parts, bushings, filters, etc.

The powder is a pre-alloyed 18-8 low carbon type that is said to be highly moldable. It is free flowing with 100 per-

continued on page 132

WE OWN THIS QUARRY

The products of this quarry have been used for many years by a nationally prominent tumbling supplier, whose name will be furnished upon request.

CHIP SIZES

#1	1¼ to 1¾	#3½	½ to ⅝
#2	⅞ to 1¼	#4	3/16 to ½
#3	⅝ to ⅞	#5	⅛ to 3/16

Other sizes on request.

Processed Limestone and Granite Chips

FOR PRECISION TUMBLING

Other tumbling supply companies charge 15c a pound for these same chips. We charge only . . .

8c LB. Packed in 100 lb. bags. Prices f.o.b. quarry.

X100 BURNISHING COMPOUND 20c LB.
(Other compound prices on request)

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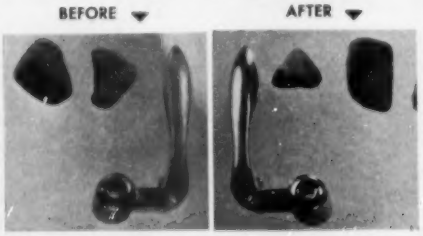

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UNIVERSAL TUMBLING SUPPLY CO.

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VALVE AND ALL OPERATING CONTROLS ARE INTEGRAL WITH THE CYLINDER. Only one air connection is required.

In pneumatic circuits the closer the valve to the cylinder, the faster, more economical and more efficient is the operation. The advantages of "close-coupling" are universally recognized by pneumatics engineers. But only Bellows offers the ultimate in "close-coupling" — an air cylinder and valve as one integral unit.

This unique Air Cylinder, with its built-in valve, is known the world over as the Bellows Air Motor. It has brought a new simplicity and effectiveness to pneumatics operation. It has created an entirely new conception of the use of air power in production processes.

In the decade since the first Bellows Air Motor was built almost 20,000 manufacturers have installed these compact power units. In many plants as many as a thousand Air Motors are in use; in many plants Bellows Air Motors operate 24 hours a day, month in, month out, building operating records of thirty, forty, even fifty million cycles.

No matter what you make, how big or how small your plants, you can use Bellows Air Motors to speed production and cut costs in a host of operations.

THIS 36-PAGE BOOKLET TELLS THE STORY . . . .

Just off the press. Filled with data every production man can use. Free on request.

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The Bellows Co.

AKRON 9, OHIO

697-A

"CONTROLLED AIR POWER" FOR FASTER, BETTER, SAFER PRODUCTION

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BEHR-MANNING® ABRASIVE BELTS give you a finish with no wild grain marks or wheel blemishes to polish out. They flex into short-radius contours, and conform to the shape of the work. They have tremendous possibilities in their hundreds of applications.

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You may get a number of valuable hints in the book *"How Polisher Pete Put Economy in Polishing."* For your copy address Behr-Manning Corp., Troy, N. Y., Dept. PR-4.

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- COATED ABRASIVES
- SHARPENING STONES
- PRESSURE-SENSITIVE TAPES

For additional information Circle No. 105 on the Reader Service Card

Product Facts

Catalogs · Manuals · Brochures

PROCESSES

Metallic Friction Materials 144
In a booklet called "Engineering Information", Raybestos-Manhattan, Inc. has given operational and design information and data on metallic friction materials for brakes, clutches, etc.

Investment Casting: 145
The advantages and uses of investment cast machine parts are discussed in a brochure available from W. H. Anderson Co., Inc.

Metal Powder Bushings: 146
Bulletin S-53 from the Amplex Div., Chrysler Corp. lists many of the available sizes and types of porous, oil-retaining bushings. The catalog also includes some design information pertinent to these products.

Shell Molded Alloy Castings: 147
The application of stainless steel shell molded castings to aircraft is discussed and illustrated in Bulletin CC54 published by Cooper Alloy Foundry Co.

The Shell Molding Process: 148
An informative booklet entitled,, "The Shell Molding Process," has been made available by the Monsanto Chemical Co.

Self-Lubricating Metal Parts: 149
A file-type folder from Brockway Pressed Meta's, Inc., gives information about the company's facilities and services for producing self-lubricating metal parts.

MATERIALS & EQUIPMENT

Beryllium-Copper Alloys: 155
The low temperature properties of beryllium copper alloys have been investigated by the Univ. of Penn. A technical report of their findings is available from the Beryllium Corp. of America.

Zinc Supplies: 156
A leaflet on the availability of zinc metal has been prepared by the American Zinc Institute, Inc.

Steel Casting Data: 157
A folder giving the steel composition, properties, heat-treatment and specification indications has been prepared by Empire Steel Castings, Inc. Some charts of properties are also given.

Brass Powder Lock Parts: 158
The use of brass powder for the manufacture of cylinder lock components is discussed in the "Metal Powder Press," for February, 1954, published by the New Jersey Zinc Co.

Casting Aluminum: 159
A new bulletin, No. 165, entitled "Practical Help in the Casting of Aluminum Alloys," has recently been published by Federated Metals Div. of American Smelting Refining Co. The 20-page bulletin gives much practical help in aluminum alloy foundry practice.

Selective Case Hardening: 160
An illustrated folder gives the properties of and the applications of the products of Denfis Chemical Laboratories, Inc. Both carburizing compounds and stop-off materials are listed and described.

X-ray Inspection: 161
The X-ray inspection of metals such as steel, magnesium and aluminum is discussed in a new 28-page booklet that has been published by E. I. DuPont Nemours & Co. Such items as exposure and processing for different types of films are covered.

Mold Release Agents: 162
A leaflet discussing the uses and advantages of silicone mold release agents has been prepared by the Injection Molders Supply Co.

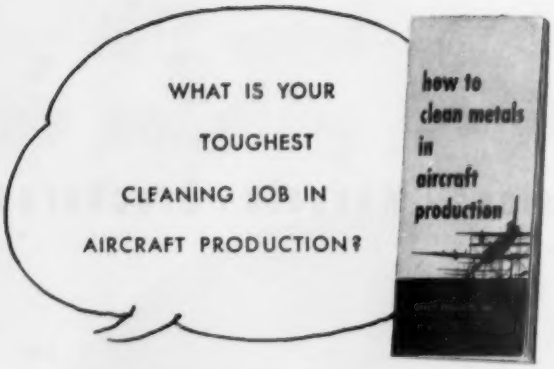
Cutting Tool Coolants: 163
Bulletin No. TB-2 of Metal Carbides Corp. gives data and shop information on coolants and lubricants for tungsten carbide tools and drawing dies. The bulletin includes the recommended coolant for machining all types of metals as well as lubricants for drawing wire, bars and tubes.

Induction Heating: 164
A new eight-page bulletin detailing the use of induction heating in forging has been issued by the General Electric Co.

Alloy Reference Chart: 165
A new alloy reference chart listing the chemical analyses, physical properties and recommended applications for 28 different grades of cast stainless steel has been made available by The Cooper Alloy Foundry Co. Data as to heat treatment and remarks concerning weldability and machinability are included.

Bonding Material for Investment Casting: 166
The use of Silester-O as a bonding agent for the ceramic investment material used to coat investment casting patterns, is interestingly presented in a 24-page brochure from Monsanto Chemical Ltd. This ethyl silicate material is reported to improve the green strength of the molds and to speed the curing stage.

continued next page



Does any job in the following list give you trouble? If you'll circle the corresponding number in the coupon, we'll be glad to tell how we can help you.

This list of cleaning (and related) jobs was made up with the advice of several of our customers in aircraft production. It shows, in order of volume, the jobs on which Oakite has most frequently been able to save them time and money. Here it is:

1 Cleaning aluminum, steel and magnesium
2 Stripping paint (solvent or hot tank)
3 Machining, grinding, forming
4 Deoxidizing aluminum
5 Steam cleaning aluminum and steel
6 Deflocculating paint in spray booths
7 Preparing metal for painting
8 Removing scale and corrosion
9 Preventing corrosion

FREE Our 48-page illustrated booklet "*How to Clean Metals in Aircraft Production*" contains information on all the cleaning jobs in the list.

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I especially wish to get better results in the jobs indicated by the numbers circled below:

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COMPANY _____

ADDRESS _____

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FINISHING

Emulsion Cleaner: 170
Complete descriptive literature on Emulsion Cleaner 75 is now available from Enthone, Inc. The literature gives applications, operating conditions and experience reports from users.

Copper Plating: 171
The phosphate copper plating process, the advantages and applications are discussed in a brochure available from United Chromium, Inc.

Industrial Washers: 172
Washing machines for industrial applications are described and illustrated in a four-page brochure available from Storm-Vulcan, Inc.

Protection Against Fire: 173
Fifteen different bulletins covering recommended procedures for protection against many difficult and unusual fire hazards are offered by Ansul Chemical Co.

Carbide Methods Manual: 174
A new edition of a Methods Manual on cemented carbides has been issued by Allegheny Ludlum Steel Corp. Included is information on tool design, brazing, grinding, chip breakers, etc.

Improved Barrel Finishing: 175
The Abbott method of barrel finishing, and a new improved tumbling barrel, are fullly described in a new brochure recently issued by The Abbott Ball Co. Intended to familiarize tumbling barrel users with barrel finishing with steel balls and shapes. It also covers the new vertical barrel produced by the company.

Blast Cleaning: 176
Pangborn Corp. has published bulletin 300C, a 28-page booklet describing the accessories and supplies available for use with Pangborn blast clelaning equipment. Included are helmets, gloves, hoses, nozzles, aprons, and blast room accessories and repair parts.

Sample of New Sanding Screen: 177
In a 4-page brochure from Carborundum Co., is included a sample of the company's new Sand Screen, which is a non-clogging, open-mesh abrasive material designed for sanding. Available in flat sheets or rolls, the material can be used for manual finishing, or can be made into built-up wheels for light deburring and polishing.

ALMCO

Supersheen

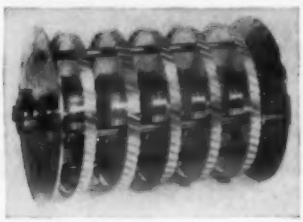
SPEED FINISHING

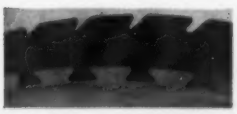
ALBERT LEA, MINN.

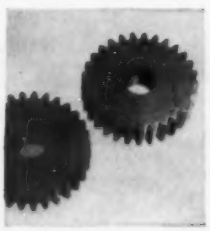
FIXTURE MACHINES FOR SPECIAL FINISHING PROBLEMS

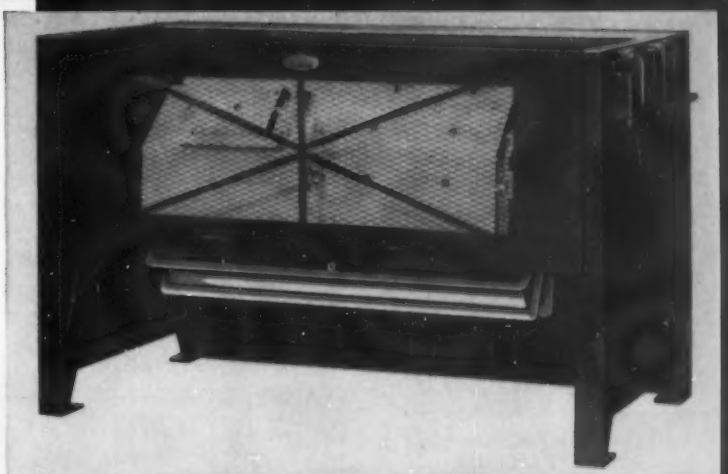
NOW . . . the tremendous cost savings of Supersheen Speed Finishing available for large, heavy, delicate, or close tolerance parts!

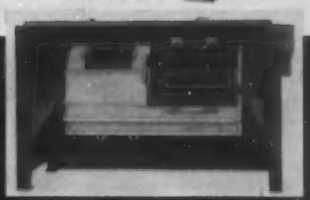
TYPICAL PARTS PROCESSED BY SUPERSHEEN FIXTURE MACHINES











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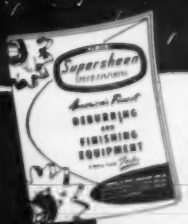
Supersheen Fixture Processing has greatly expanded the field for modern barrel finishing. Now many parts—formerly impossible to barrel finish—can be Supersheen finished at enormous cost savings. Supersheen Fixture Processing eliminates all former costly hand methods of filing, deburring, etc., thereby making great savings possible.

WHAT IS YOUR PROBLEM? Write us about your specific parts finishing requirements. We'll gladly show you how Supersheen can save you a great deal of money.

Free Catalog

Get the complete money-saving facts. Send the coupon for the new extremely complete 52-page catalog "Supersheen Speed Finishing". See scores of "before and after" pictures of many different parts. Learn the latest on new equipment and compounds. LEARN HOW SUPERSHEEN FIXTURE MACHINES CAN SAVE YOU MONEY.



MAIL COUPON TODAY

Almco Supersheen, Queen Stove Works, Inc., Dept. D-4
Albert Lea, Minnesota

Gentlemen: Please rush me your new catalog "Supersheen Speed Finishing" and complete details on your Fixture Machines.

Name _____ Title _____

Address _____

City _____ State _____

Specify PARKER-KALON®

The Original SELF-TAPPING SCREWS

. . . make sure *planned* assembly savings *pay off*

Originator and largest manufacturer of Self-tapping Screws, Parker-Kalon can guarantee the proper combination of hardness and toughness, the sharp, clean threads, the dimensional accuracy, the uniform first quality you need to keep assembly trouble-free. Since P-K makes many types, you can fit the right fastener to the job, *not* the job to a particular fastener.

Type A
SLOTTED OR PHILLIPS

For light gage (.015 to .050") sheet metals, compositions, plywood, wood, etc.

Type Z
SLOTTED OR PHILLIPS
A.S.A. Type B

For light and heavy gage (.015 to .200") sheet metals, non-ferrous castings, plastics, plywood, compositions, etc.

HEX HEAD
Type Z
A.S.A. Type B

For light and heavy gage sheet metals and structural steel (.200 to ½"), non-ferrous castings, plastics, plywood, compositions, etc.

Type F
SLOTTED OR PHILLIPS

For ferrous and non-ferrous castings, bronze or brass forgings, heavy gage sheet metals, structural steel, plastics, plywood, etc. Cuts machine screw thread.

Type F-Z
SLOTTED OR PHILLIPS

For fastenings to thin sections and bosses in brittle plastics. Five cutting flutes distribute pressure evenly. Coarse threads resist stripping out.

HEAD STYLES

Types A, Z, F, and F-Z are available with any commonly used head styles

Type U
DRIVE SCREW

For permanent fastenings to ferrous and non-ferrous castings, heavy gage sheet metals, plastics, etc. Easily adaptable to press or hopper feed screw driving machines.

Type 21
DRIVE SCREW

For permanent fastenings of fibre, leather, fabric, etc., to sheet metal. Designed especially for fastening anti-squeak, upholstery, windlace, etc., to auto bodies.

SPECIAL FORMS

Variations of standard forms of all types of P-K Self-tapping Screws can be furnished on special order, quantity permitting.

STAINLESS STEEL

P-K Self-tapping Screws can be furnished to meet all requirements of applications where fasteners are subject to corrosive conditions. Made in Type 302 (18-8), Type 410, other metals as required. Ask for complete information.

STAPS STAPS are P-K Fasteners with pre-assembled neoprene washers of various types. STAPS have many applications, such as effective control of leaks and electrolysis, prevention of squeaks under vibration, cushioning porcelain enamel or other brittle finishes against fastener pressure to avoid cracking. All types of P-K Self-tapping Screws, and Screwnails, are available as STAPS. Ask for complete information.

OTHER P-K FASTENERS

HARDENED SCREWNAILS

Fasten sheet metal to wood with nail-driving speed, but have over 4 times the holding power of nails. Do not work loose or back out.

Cold-forged WING NUTS and THUMB SCREWS

SOCKET SCREWS

ASSEMBLY PLANNING AIDS

Catalogs, booklets, charts that give clear, complete information on every phase of P-K fastener selection and application. Typical is the 68-page P-K Engineering Standards book.

ASSEMBLY ENGINEERING SERVICE

At your request, a P-K Assembly Engineer will make recommendations based on a 35-year experience covering millions of applications. PARKER-KALON DIVISION, General American Transportation Corporation, 200 Varick St., New York 14.

For additional information Circle No. 111 on the Reader Service Card

Standards for Metal Powders and Metal Powder Products

DURING recent years, much thought and effort has been applied to the development and acceptance of standards for metal powders, green compacts and products formed from metal powders. Listed here are standards and tentative standards established thus far by the Metal Powder Association.

1- 45 Method for Sampling Finished Lots of Metal Powders
2- 48T Tentative Method for Determination of Hydrogen Loss of Metal Powders
3- 45 Method for Determination of Flow Rate of Metal Powders
3- 45 (Supplement) Report on Precision of Above Method
4- 45 Method for Determination of Apparent Density of Metal Powders
4- 45 (supplement) Report on Precision of Above Method
5- 46 Method for Sieve Analysis of Granular Metal Powders
6- 48T Tentative Method for Determination of Insoluble Matter in Iron and Copper Powders
7- 49T Tentative Methods for Determination of Iron Content of Iron Powder
8- 50T Tentative Method for Acceptance Tests on Structural Parts Made From Metal Powdedrs
9- 50T Tentative Definitions of Terms Used in Powder Metallurgy
10- 50T Tentative Standard Tension Test Specimens for Pressed and Sintered Metal Powders
11- 52T Tentative Electronic Iron Core Preferred Dimensional Specifications
12- 51T Tentative Method or subsieve Analysis of Granular Metal Powders by Air Classification
13- 51T Tentative Method for Determination of Bending Strength, Green Density, Hardness and Shrinkage of Compacted, Sintered Metal Powder Specimens
14- 51T Tentative Metal Powder Sintered Bearings (Oil Impregnated) Preferred Dimensional Specifications
15- 51T Tentative Method for Determination of Green Strength of Compacted Metal Powder Specimens
16- 52T Tentative Specifications for Metal Powder Sintered Bearings (Oil Impregnated)

(Note: All of the above specifications can be purchased from the Metal Powder Association, 420 Lexington Ave., New York 17, N. Y. for 25c per copy).

"BLIND DATES" MAY BE ALL RIGHT FOR VISITING FIREMEN,

but you can't afford to risk the quality and reputation of your product on an unknown source of supply:

Jersey Plastic & Die Casting Company has been in the business many years; we're proud of our long list of customers who keep coming back because they like the work we do. We invite you to investigate our plant, look at some of the thousands of different castings we have produced, and give us a chance to quote on your castings. Our engineers will gladly advise you on any technical problems you may have with your die casting designs.

It will pay you to look into this dependable source of die castings. Write for our free booklet.

JERSEY PLASTIC & DIE CASTING CO.
148 Shaw Avenue, Irvington 11, New Jersey

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Die Castings by MILWAUKEE

...for Extra Values at No Extra Cost!

A pioneer in its field, Milwaukee offers you the experience and knowledge gained in helping others for more than 40 years, to realize the full benefits of the die casting process. In its modern plant, it offers you the most advanced facilities for the production of zinc and aluminum die castings. These extra values which cost you no more, can help you build extra values into your product, too.

We operate under the Certified Zinc Plan of the American Die Casting Institute, Inc.

MILWAUKEE DIE CASTING COMPANY
4146 N. HOLTON STREET • MILWAUKEE 12, WISCONSIN
Established 1909

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NEW!

HIGH SPEED
A.B.C. DIE CASTING
MACHINE

Free Cycles Over 1000 Shots Per Hour

Here's the new A·B·C high speed, low cost die casting machine which eliminates costly production of small die castings on large die casting machines. Air operated, the machine produces small non-porous lead, tin and zinc alloy precision die castings up to 1½ lbs.

The A·B·C is economical to operate and easy to set up. Its lightning production speeds makes single cavity molds practical and profitable.

STANDARD EQUIPMENT INCLUDES:
- 4 TIE BARS
- AUTOMATIC TIMING
- CALIBRATED TEMPERATURE GAS CONTROL
- GAS BURNERS
- DIE BLOCKS
- AIR REGULATOR
- FILTER
- OILER
- SAFETY SHOT INTERLOCK

Write today for engineering data and prices. Ask for bulletin A-10.

A B C
DIE CASTING MACHINE CO.
339 W. 112th PLACE • CHICAGO 28, ILLINOIS

Reduce RING COST and DOWNTIME with AUTO-DIESEL PLUNGER RINGS...

Here is a new hardened steel Plunger Ring that will really last. In actual service our rings have lasted over 122 days — they were immersed in molten zinc over 800 hours. This is a record that we are justly proud of. Auto-Diesel Plunger Rings are made of cast iron, dieloy cast iron or hardened steel. Ring failures are costly in down time as well as in replacement cost. These expenses can be reduced to a minimum with Auto-Diesel Plunger Rings. If you are operating die casting machines or casting zinc parts it will pay you to investigate.

AUTO-DIESEL TWO PIECE PLUNGER SEGMENT RINGS.. are especially made for hot chamber diecasting machines

We can supply Two Piece Plunger Segment Rings for hot chamber die casting machines. These Rings are especially made for this type of work by men who have been making quality Rings since 1921. Casting sizes available:— 1½", 2", 2¼", 2½", 2⅝", 2¾", 2⅞", 3", 3½", 3¾", 3⅞", 4" by ⅞". Write today for prices. We can make prompt delivery.

Write for Details

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"RINGS and SHAPES Since 1921"

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OPPORTUNITIES

FOR SALE — No. 56F1 Standard Die Cast machine 6 years old, 5" tie bar — 36" x 23½" center, Aluminum only — $9,800. No Dealers. Write Box No. 4354 PRECISION METAL MOLDING magazine.

DIE CASTING OPPORTUNITY: — Long established die casting plant on Pacific Coast has opening for a man that knows his business as foreman of die casting department. State background, experience and salary now earning. Confidential. Write Box No. 4254 PRECISION METAL MOLDING magazine.

POSITION WANTED — Die-Cast foreman experienced zinc and aluminum. Willing to relocate. Write Box No. 4154 PRECISION METAL MOLDING magazine.

CANADIAN UNIT MOVES

Dr. W. R. Collings, vice president and general manager of Dow Corning Corporation, has announced that its recently organized Canadian subsidiary, Dow Corning Silicones Limited, has moved into its new office and warehouse building on Tippet Road, Wilson Heights, Toronto and began doing business as of February 1.

The home of Dow Corning's Canadian company is conveniently located in metropolitan Toronto and contains 2000 square feet of office space and 100,000 square feet of warehouse area.

Dow Corning Silicones Limited has taken over the sales service and warehousing operations which since 1945 have been carried on by Fiberglas Canada Limited as Canadian distributors of Dow Corning products. The Fiberglas personnel who have been engaged in the sales of silicones have been taken into the employ of the new company.

NEW HANDBOOK GIVES METALS PROPERTIES

The second volume of the ASME Handbook, entitled **Metals Properties,** is now available through the McGraw Hill Book Company. (The initial volume, **Metals Engineering-Design,** was published in October, 1953.) Sponsored by the Metals Engineering Handbook Board of the American Society of Mechanical Engineers, the complete ASME Handbook will consist of four volumes, the remaining two to be published during 1954.

Metals Properties contains a wealth of tabulated engineering data on the metallurgical, physical, fabrication and mechanical properties of typical metals and alloys.

In convenient chart and table form, this book provides data on more than 500 metals in common industrial use — AISI and ASTM steels, cast copper alloys, aluminum alloys, tin, magnesium, etc.

Tabulated under each of the metals listed in such information as: the chemical composition of the metal; its brittleness, heat treatments, and other characteristics; its industrial uses; treatment temperatures for forging, annealing, quenching, etc.; and technological properties such as recrystallization temperature and hot working temperature

This volume was prepared under the editorship of Samuel Hoyt, Metallurgical consultant, Battelle Memorial Institute.

Metals Properties retails at $11. Further details are available from McGraw-Hill's Book Information Service, 327 West 41st Street, New York 36, N. Y.

SETS UP DETROIT BRANCH

A new sales office and warehouse was recently established in Detroit by the Metal Removal Co., Chicago manufacturer of abrasives and die sinking tools, Charles E. Davis, president, announced.

DIE CASTER-TOOL MAKER VOTE ON MERGER

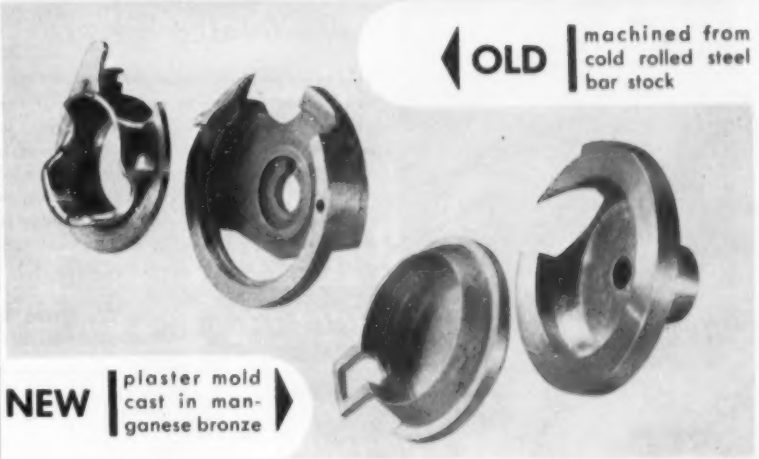
A proposal to merge Portable Electric Tools, Inc., Chicago, and Admiral Die Casting Corporation, was voted upon at special meetings of shareholders of the two companies March 26.

The proposal called for an exchange of Admiral Die Casting Shares for those of Portable, with the former company becoming an operating division of the latter.

Portable is a manufacturer of portable electric drills and other homeshop and industrial tools. Sales in the fiscal year ending June 30, 1953, totaled $12,110,000.

At the time PMM went to press, outcome of the voting had not been announced.

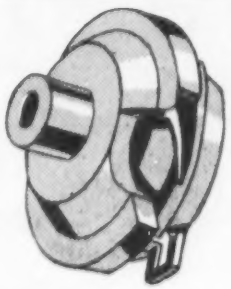
A stitch in time — on these sewing machine parts . . .



SAVED 50%

with plaster mold castings by Universal

Two castings replace a three-piece assembly that had to be turned, milled, drilled, shaped, filed, ground, heat-treated and polished.



This sewing machine unit holds the bobbin and controls the thread and stitch. Vital to smooth machine operation, it has to meet high strength, dimensional tolerance and surface finish requirements. As machined parts, trouble was encountered on all three scores: failures cropped up on the hook section despite heat-treating; rough spots sometimes snagged the thread. As plaster mold cast by Universal, the parts are held to tolerances of .005" per inch. They need no heat-treatment: their minimum tensile strength is 100,000 psi. The chrome plated castings give fine wearing quality without snagging. If high cost, tolerances or poor surface finish is your problem, then check with Universal.

• *Write today for your free copy of illustrated brochure — P-152.*

UNIVERSAL CASTINGS CORP.

5821 W. 66th St. Chicago 38, Illinois

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For additional information Circle No. 91 on the Reader Service Card

Spincraft
SKILL WILL DO IT ®
stainless steel
Ladles...
for die casting
give you these advantages

- easier pouring
- increased output
- longer service life
- increased safety

Because Spincraft ladles of stainless steel are so much lighter in weight, because they are so resistant to high temperatures, because they so positively lower costs in all directions, they are now in use in over 200 die casting plants everywhere—including the country's leading producers. Write today for an informative bulletin illustrating Spincraft's wide range of ladle sizes.

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TRADE-MARK
hydrolubes...

and NON-FLAMMABILITY

UCON hydrolubes are hydraulic fluids that contain water for non-flammability. They are balanced formulations of water, an anti-freeze, and a water-soluble synthetic lubricant. They contain carefully selected corrosion inhibitors, metal deactivators, and anti-wear agents. As long as the water concentration is maintained, UCON hydrolubes are non-flammable.

For safety, economy, and efficiency—switch to UCON hydrolubes. They can be used with conventional packings and seals—without revamping.

Write today for the booklet, "UCON Hydrolubes," F-7380.

Carbide and Carbon Chemicals Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

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McCARTHY HEADS SALES FOR CHICAGO POWDERED METALS

J. E. Miller, president of Chicago Powdered Metal Products Co., Schiller Park, Ill., has announced the appointment of William L. McCarthy as executive sales manager. Mr. McCarthy has held similar posts in the precision investment casting and electronics industries.

Simultaneous with the announcement of Mr. McCarthy's appointment, Mr. Miller has also announced that the moving of all company and factory operations to a new plant at 9700 Waveland Ave., Schiller Park, has now been completed.

Wm. L. McCarthy

The move increases the company's floor space to about 10,000 square feet, an increase of 50 percent in capacity.

HOWARD FOUNDRY DIV. TO CAST TITANIUM

Richard S. Morse, president of National Research Corp., Cambridge Mass., has announced today that the first non-exclusive license agreement covering the NRC Titanium Shape Casting Process has been granted to the Titanium Casting Corp., division of Howard Foundry Co., Chicago.

Over a period of several years, National Research has carried on research work directed towards the development of a process for the production of cast shapes of titanium which involves special melting furnaces, casting procedures, and mold materials capable of withstanding the attack of molten titanium.

REFERENCE DATA
continued from page 16

91. STAINLESS STEEL LADLES for handling molten metal are described and the complete line illustrated in the Spincraft catalog.

98. INJECTION MOLDING MACHINES for the investment casting industry are described in the Van Dorn Iron Works Co. catalog.

101. THE ADVANTAGES AND LIMITATIONS of powder metallurgy are discussed in a booklet from Yale & Towne Mfg. Co., Powdered Metal Products Div.

102. WHAT IS IRIDITE and how is it applied? A booklet from Allied Research Products, Inc. describes this metal finish.

103. SPEED FINISHING by the Supersheen method and fixture machines are described in the Almco Supersheen, Queen Stove Works, Inc. catalog.

105. ECONOMICAL METAL POLISHING is described in a booklet from Behr-Manning Corp.

108. TUMBLING BARRELS and all necessary supplies for barrel finishing metal parts are listed in the Grav-i-Flo Corp. catalog.

110. METAL CLEANING is described in a 48-page manual "How to Clean Metals in Aircraft Production", issued by Oakite Products, Inc.

1. SMALL DIE CASTING machines are subject of catalog offered by A. B. C. Die Casting Machine Co.

18. COMPACTING PRESSES for powder metallurgy are presented in a catalog from Baldwin-Lima-Hamilton, including complete specifications and details.

37. HOW TO USE electrolytic iron powder in product design and processing, is the subject of literature offered by Plastic Metals.

82. BEARINGS, STRUCTURAL parts, and other applications of powdered metals are presented in a brochure from Powdercraft.

85. INFORMATION concerning hydrogen reduced iron powder is offered by Pyron Corp.

92. MELTING EQUIPMENT for wax pattern work in investment casting, is the subject of literature from Sta-Warm.

111. ASSEMBLY PLANNING AIDS, including a 68-page book on engineering standards, are available from Parker-Kalon, relating to the many types of P-K self-tapping screws and other fasteners.

26. DIE CASTING MACHINE catalog giving the complete story of all sizes of machines as well as basic engineering information is available from Cast-Master, Inc.

continued next page

Compare
PARAGON'S PERFORMANCE
with others when you need
ALUMINUM and ZINC BASE
DIE CASTINGS

For superior design, better appearance and greater strength . . . select PARAGON Die Castings. They are everything the name implies.

Consult any office listed below or contact us directly.

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SALES OFFICES: DETROIT • INDIANAPOLIS • CHICAGO • MILWAUKEE

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REFERENCE DATA — cont.

30. SOLVE YOUR HEATING ELEMENT PROBLEMS by using Globar non-metallic elements. For engineering reports and data on these elements write the Globar Div., The Carborundum Co.

12. THE CERTIFIED ZINC PLAN, what it is and how it operates is described in a booklet available from the American Die Casting Institute.

121. RZ IRON POWDER, the compositions available and the pressing and sintering characteristics are given in a brochure from Easton Metal Powders Co., Inc.

41. COPPER POWDER essentially free of oxide and said to have from 5 to 10 times the stability of other copper powders is described in literature available from The Glidden Co.

here's how
(AND WHERE)
to end your SMALL PARTS problems
GRC DIE CASTINGS . . . give you economy, plus almost unlimited design flexibility. From the simplest to the most complex designs, GRC zinc alloy castings meet size, shape and tolerance specifications precisely — and uniformly! They come to you ready for assembly without further machining; quantities of 100,000 to many millions.
AT THE MODERN GRC PLANT . . . tiny nylon and other thermoplastic moldings, as well as zinc alloy die castings, are formed in one piece and in one high-speed, low-cost automatic operation. Tooling costs are low, there is no scrap loss, and secondary operations are virtually eliminated. Cast or molded GRC tiny parts may be the difference between success and failure of your new design.
Maximum Wgt. | Die Cast ½ oz.
Maximum Lth. | Parts 1-¾"
Write for bulletin and samples today. Send prints for quotations.
GRIES REPRODUCER CORP.
World's Foremost Producer of Small Die Castings
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GRC
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59. MELTING FURNACES featuring the two chamber design are described and their advantages given in bulletin 560 from Lindberg Engineering Co.

65. PRE-ALLOYED METAL POWDERS for addition to pure iron powder to give increased strength to powder compacts are described in information available from Metal Hydrides, Inc.

76. BRASS POWDER applications and techniques are described in a booklet from the New Jersey Zinc Sales Co.

77. DIMENSIONING DIE CASTINGS, an engineering and design manual for users and prospective users of die castings is available from the Newton-New Haven Co.

92. WAX MELTING EQUIPMENT and warming pots are described in Sta-Warm Electric Co. literature.

122. DESIGNING PARTS FOR POWDER METALLURGY with engineering data on the applications of sintered structural parts is all in bulletin No. MP-532 published by Thompson Products Corp.

114. ENGINEERING DATA AND APPLICATION of air operated devices are given in a 36-page booklet from the Bellows Co.

106. SAND SCREENS, a new development in abrasive papers and cloths are described in literature from the Carborundum Co.

107. METAL FINISHING through the use of Luster-On cuts finishing costs and gives a superior finish, according to literature from the Chemical Corp.

109. BARREL FINISHING MANUAL, a complete engineering report on methods and equipment, is available from Minnesota Mining & Mfg. Co.

BRAKE AND CLUTCH SURFACES
continued from page 38

motor disconnected, and the clutch engaged bringing the flywheel to rest. The procedure is repeated for 1000 cycles. The selection of flywheels is dependent upon the kinetic energy desired. Measurements of disc wear and distortion are taken after the completion of test.

It has been possible by use of this type of dynamometer testing to predict successfully the performance characteristics of friction materials in full-scale operational tests.

Accurate product control is an important factor in the production and development of metal powder friction materials. Compositions can be altered to meet specific requirements, hence, it is necessary to hold consistency once a material is approved. To supplement dynamometer production control, the raw materials are thoroughly checked for quality, and a sample of each batch of mixed powder is chemical analysis.

In addition to marked advancements in material development and control, great strides have been made in the economy of fabrication through the design of automatic metallurgical and finishing equipment. With the use of automatic briquetting presses, compacts are molded as rapidly as eight per minute compared to a rate of one every two minutes with older methods. Special automatic finishing machines have increased production rates many fold resulting in a premium product competitive, costwise, in most cases to ordinary friction materials.

Today metal powder friction material uses are varied and widespread, covering almost every field and application where a friction surface is required.

L. P. KANE . . .

author of this article, has served the S. K. Wellman Co. in various capacities since 1940, and has been in sales engineering since 1950 doing contact work regarding brake and clutch friction problems.

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...for complete satisfaction

CHOOSE **HENNING**

ZAMAK (Zinc Base) DIE CASTING ALLOYS

Once you taste the difference between ordinary alloys and H. B. & S. you'll never have an appetite for anything but HENNING products.

We strap Zinc Base Die Cast bars on metal pallets of the same alloy to speed handling in your plant. H. B. & S. alloys meet all Government, ASTM and SAE specifications.

Shipments made promptly by truck or carload lots from our own private railroad siding.

(On that next order specify HENNING and be convinced of the difference.)

Are you receiving our monthly publication THE HENNING MESSENGER? We believe it will give you a chuckle or moment's relaxation during a busy day. Ask to be put on our mailing list.

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"DEPENDABLE SERVICE SINCE 1922"

For additional information Circle No. 44 on the Reader Service Card

Blinders Look Fine on a Horse—

but pretty silly on a user of castings

BLINDERS on a horse keep him from shying. But when a user or maker of castings wears 'em, so that he can't see an idea that will make more money for his company — *that just isn't horse sense.*

Take impregnation-sealing of porous castings*, for example. There are still a few who "can't see" it. Yet, for hundreds of progressive companies, modern impregnation methods and materials developed by Tincher have reduced rejections of castings to an all-time low. These companies are saving money like crazy — and they haven't lowered quality by the shadow of a percentage point!

No doubt about it — impregnation-sealing has "come of age" and it's here to stay . . . quite largely because of Tincher research and engineering. New, proven Tincher IMPREX Metallic Sealants give deeper penetration for positive sealing. Still newer IMPREX Plastic Sealants cure very coarse porosity — permanently stop even "squirters".

Want the proof? Just send us a sample batch of castings that you've found to be porous. We'll pay the shipping costs both ways — impregnate them and send them back to you. *Then you test them any way you like!* NO COST OR OBLIGATION — but we're betting you'll eliminate porous castings as a problem forevermore! Send the coupon for shipping instructions today.

TINCHER IMPREX PROCESS

*Castings that must withstand liquid or air pressures and which have been rejected after tests as "leakers."

SEALS FOR HIGHER QUALITY, MORE PROFITABLE PRODUCTION

TINCHER PRODUCTS COMPANY, 819 Borden Ave., Sycamore, Ill.

Please send shipping instructions for my sample batch of castings consisting of _____ pieces. They weigh about _____ each and are _____ (give approx. dimensions) in size.

Name _____

Title _____

Company _____

Street _____

City _____ Zone ____ State _____

For additional information Circle No. 95 on the Reader Service Card

THREE WAYS TO USE
continued from page 45

be done in any event. Rather than hold the foundry to greater than normal dimensional accuracy with consequent increases in piece costs, all dimensions are fairly open.

Where a press fit or an accurate bore is required, resort is made to machining. For example, in the back cap, neither the inside rabbet, which must be held to a total tolerance of 0.002, nor the spherical seat for the self aligning bushing, can be economically cast to size; they are both, therefore, machined.

The front cap also contains a spherical bushing and rabbet so that the same machining must be done on this part as on the back cap. In addition this piece has a steel pin insert. Because the section thickness has been held down in all cases, special pressure pads were incorporated for the ejector pins in the die to work against. In both castings these pads are the four bosses shown near the bearing ring. The die for the front cap was designed so that one of these pressure pads was in the proper position to act later as a receiver for the insert. Obviously, then, the hole for the pin could not be cored and must be drilled and reamed after casting and the pin pressed in. Accuracy of location of this pin and die construction costs precluded the use of a cast-in insert.

The gear case has been briefly touched upon in discussing the two bushings that it carries. This piece is cast ready for use except for threading the OD and borizing the cored bushing hole.

Electrical connections are brought out through cored holes and a slot is provided to hold special nylon fitting to both insulate and seal against moisture intrusion.

The two other die castings used are the spanner nut and the crank plate. The spanner nut needs only internal threading to be ready for finishing while the crank plate has to have a pivot pin hole drilled.

All of the aluminum die castings used are made by the Doehler-Jarvis Div. of National Lead Co. and all of them show how the flexibility of the die casting process has been fully used.

Finish of all parts is by black anodizing and only enough surface sanding is done to remove flash and parting lines.

MOTORCYCLES AND BICYCLES
continued from page 42

high impact loads and wear. It has given excellent results and the wear of the part in road tests was at least 30 percent lower than with the screw machined part.

The second part is a lock nut for two-speed gear hubs and is submitted to rather high impact loads. Even here sintered steel has proved successful. Table III shows to what extent this part can be more economically made by powder metallurgy. A similar comparison is made with regard to raw material and production time for 100 parts.

The products of the Husqvarna powder metallurgical department are not only used in the company's plants but are also sold to a certain extent to other European manufacturers of similar products.

The methods developed are being used, not only in Sweden, but also in France, Italy Germany and England, where there are licensed companies. Many products such as motor cars, sewing machines, calculating machines bicycles and motorcycles are fitted with high density structural parts made by this process.

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View showing Sta-Warm wax pot with inner liner lifted, revealing many feet of specially wound heating element surrounding side walls. Bottom of liner is similarly wound.

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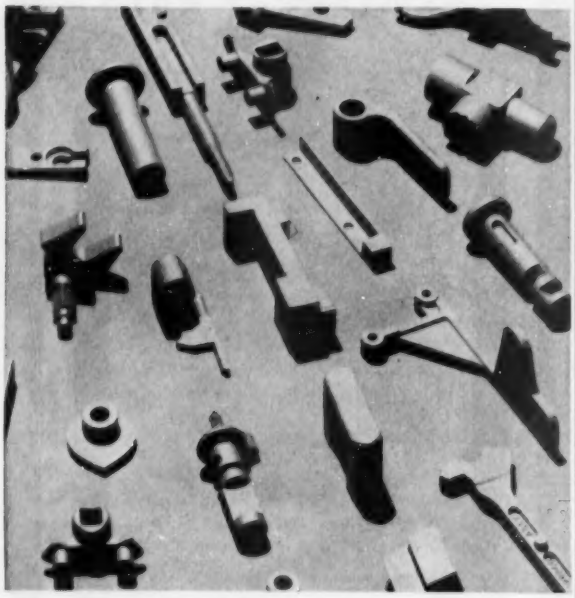

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continued from page 58

mum. Too large an opening will lead to a weaker joint and a possible lack of infiltration. Figures 1 and 2 show a good and a bad brazed joint. It should be noted in Figure 1 that the junction line is virtually indistinguishable from the infiltrated sections. Figure 2, however, shows progressively a satisfactory junction, then an area of copper only and finally an area of no fusion. Both figures were taken from the same part which was molded and sintered as two separate sections, coined together and then infiltrated. It should be feasible to braze powdered sections to stampings and similar items, although we have never had occasion to try this.

We have not offered infiltration as an panacea for all the troubles along the road to high density parts. In many cases the added cost of the infiltrant have made parts noncompetitive. The cost of building and maintaining fixtures for the high temperature operation is frequently high. There is, however, a very definite field for the infiltrated part. In this field the parts will not only be competitive in price but will also be equal or superior in performance.

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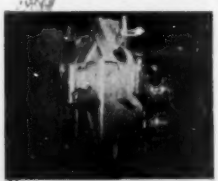

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Industry News

Companies · Plants · Associations

INTERNATIONAL POWDER METALLURGY FORMS NEW DIVISION FOR WESTERN AREA

Plans for the organization of the Rocky Mountain Metals Division and the erection of a new plant in Colorado Springs, Colo., has been announced by M. T. Victor, president of the International Powder Metallurgy Co., 439 West Main St., Ridgway, Penna.

When completed, the new plant will provide 10,000 square feet of space and will be completely equipped with the most modern engineering, research, and production facilities. The plant is expected to be in operation by June and will make powdered metal parts for industrial and consumer products.

E. G. Smith, formerly superintendent of the company's Ridgway plant, was appointed general manager of the new division. R. A. Trimble has been promoted to superintendent of the Ridgway plant to succeed Mr. Smith.

INVESTMENT CASTING INSTITUTE SETS UP PROGRAM . . .

Officers and directors of the newly founded Investment Casting Institute are shown above as they gathered in Cleveland last month to outline and expedite an ambitious program of activity. Pictured are: (left to right) Ken Yonker, Howard Foundry Co.; R. S. Banister, Midwest Foundry Co.; R. D. Gumbert, Alloy Precision Casting Co.; W. A. Dubovick, Engineered Precision Casting Co.; K. M. Bartlett, Thompson Products Inc. and Ted Operhall, Misco Precision Casting Co.

A general meeting of the I. C. I. to which all manufacturers of investment castings are invited, will take place May 7 at the Hotel Carter in Cleveland.

Current program of the Institute includes: 1) a comprehensive survey of facilities and capacities of the industry; 2) a survey analysis of users of investment castings; 3) procurement of the services of a competent consultant, Dr. Nicholas Grant, Associate Professor of Metallurgy at M. I. T.; 4) development of technical committees; and 5) preparation of a bulletin to review current technical literature.

National Carbide Die Expands Again

Shown above is a partial view of the fourth expansion of facilities in as many years at National Carbide Die Co., McKeesport, Pa. This latest addition consists of 5800 square feet that will, primarily, be used for the fabricating of tungsten carbide deep draw dies from the smallest diameter up to and including 36 inches.

DIE CASTING IN 1954 TO BE LAINE'S TOPIC

Speaking before the American Zinc Institute when it convenes in St. Louis April 20-21 for its 36th annual meeting, David Laine, secretary of the American Die Casting Institute will report on, "The 1954 Die Casting Program."

Mr. Laine is one of several speakers on various phases of zinc usage, in addition to which there will be a survey discussion of the zinc situation.

Here's how 13 Twin City Castings prove LUCKY in this SCOTCH BRAND Tape dispenser

13 TWIN CITY CASTINGS USED IN TYPE "M" BOX SEALER

Here was a job that called for *more* than accurate dies and close-tolerance castings. It called for *co-operation* between designer and die caster . . . the kind of cooperation so important to creative manufacture.

Result: an extremely successful manually operated box sealer for use with Scotch brand cellophane tape. The unit is built by Specialty Manufacturing Company for Minnesota Mining and Manufacturing Co., manufacturers of Scotch tape. The dispenser contains 13 zinc die castings from complex main frame to small trip-pin arm . . . all *Twin City* die castings and *Twin City*-built dies.

If you have a particular die casting job, large or small, that calls for "cooperation" with your die caster . . . contact Twin City. Hundreds of manufacturers have found that it pays.

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BERYLLIUM COPPER ALLOYS STAND UP IN SUBZERO COLD STUDY AT U. OF P. SHOWS

A two-year study completed at the University of Pennsylvania, the results of which are now made public by The Beryllium Corporation, discloses that mechanical properties of beryllium copper are able to withstand extreme temperature conditions as low as minus 300F.

The study shows that the alloy in some respects displays improved performance in the subzero range.

These findings are expected to have important bearing on the types of design materials used in equipment operating in intense cold. Such equipment would include aircraft parts and instruments, radar and devices for handling refrigerants and liquefied gases.

Conducted under the direction of Dr. Robert M. Brick, head of the University's Department of Metallurgical Engineering, the study was sponsored by The Beryllium Corporation, Reading, Pa. Tests were confined to commercial types of wrought and cast beryllium copper alloys, marking the first time low-temperature studies have been made upon commercial grades of alloy.

Starting at normal room temperature, beryllium copper was tested for performance at successive levels down to minus 300F a record low for testing the alloy.

Among important properties measured were tensile and impact strengths, elongation, and elastic modulus. Results indicate that beryllium copper performs with unhampered and even heightened efficiency under subzero conditions that generally cause failure in other standard materials.

Details of the two-year study, along with conclusions and interpretations of the findings, are available as a four-page Technical Bulletin from The Beryllium Corporation, Reading, Pennsylvania.

DESIGN FOR BEARINGS
continued from page 52

ample, will it be by drilling and reaming, boring, broaching, etc.?

Again the master mechanic may wish to work with a reamer of standard size, oversize, or undersize to effect maximum economy. Reamers undersize from another part may be employed. Or new oversize reamers may be used and transferred when worn. Knowing all this plus the amount of the press fit he readily computes the final OD and tolerance. He makes certain that the tolerance is liberal.

Bearing Length

Having the load, the inside diameter of the bearing, and the permissible stress per square inch, Chart A, the length of the bearing is readily calculated. At this point the designing engineer makes a final check with regard to the factor of safety. This is particularly important on new designs and on applications where unusual factors are present, such as possible overloads, abnormal temperatures, misalignment, abuse in service, etc.

Sizing the Bearing ID After Assembly

The designing engineer has ascertained from the master mechanic just how this bearing will be assembled and the bore finish sized. Here again the type of bearing we describe offers opportunities for appreciable economy. To finish the bore of the bearing by reaming is expensive and generally leaves much to be desired with regard to the finish of the bore and the accuracy of same.

Fortunately the heavy duty, oil cushion, self-lubricating bearing can be finished by methods and processes that are most inexpensive. For example, the bearing may be mounted on a stub arbor of such a diameter that, after the bearing is assembled and the arbor pressed out, the bore is to size and within very narrow limits. It is to be noted that this procedure is possible only because the bearing is porous and oil impregnated.

Again the bearing may, after assembly, be finish sized by means of a burnishing tool or a sizing arbor, preferably the first. The assembly operation may be performed by hand on an arbor press, on a hydraulic, mechanical or pneumatic press, or in a machine tool such as a drill press or turret lathe. When a drill press is employed the burnishing tool revolves, while in the lathe the work, of course, is revolved. Furthermore, the burnishing tool may be of a piloted type so that

continued next page

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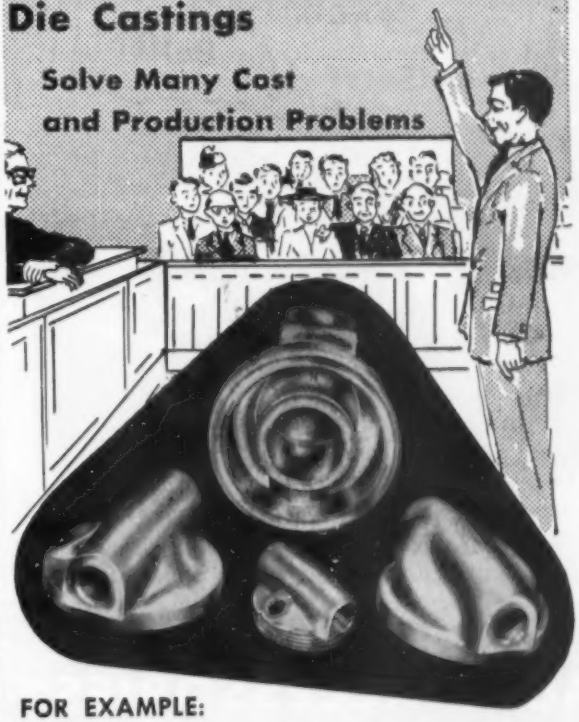

FOR EXAMPLE:

The heads for air line lubricators and filters shown here have been ideal *solutions* for designers and engineers who have been on the *trail* of production costs. Cost Savings resulting from virtual elimination of machining labor combine with the attractive designs permitted by die casting. They open new markets for these products as produced by such manufacturers as Keller Tool Co. and Master Pneumatic Supply Co. for a highly competitive field.

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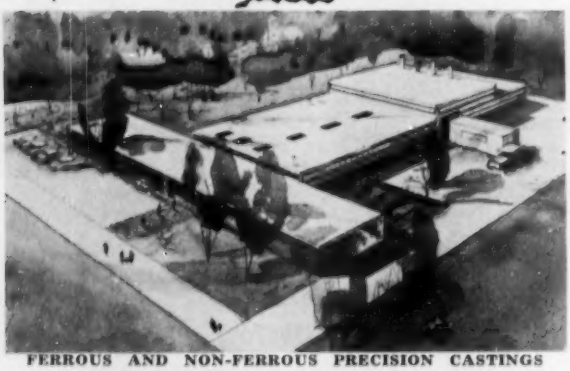

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DESIGN FOR BEARINGS — cont.

perfect alignment of the bearing is assured.

An invaluable feature of this type of finishing is that the apertures of the oil feeding pores are not closed. Reaming and boring, unless employing tools of proper design, material, cutting angles, cutting speed, etc. close the pores, destroying a major feature of the heavy duty, self-lubricating bearing.

Oils and Greases

Lubricating oils and greases are a big subject in themselves. It is to be noted that a self-lubricating bearing, for example, does not require any special oil. However, all of our bearings are impregnated with special, trouble-free oil. Even this oil is supplanted by special oils if service so dictates. For example, an ordinary oil will congeal at low temperatures so that a special oil is required if temperatures are of the order of minus 40 F. For high temperatures, too, we have had special oils developed. Still more special oils are used where food products may be involved, chemical products, or other duties of special and severe nature.

Bearing or Shaft Clearance

The matter of bearing clearances is an important item. As bearing clearances increase the effective bearing area decreases. Noise is

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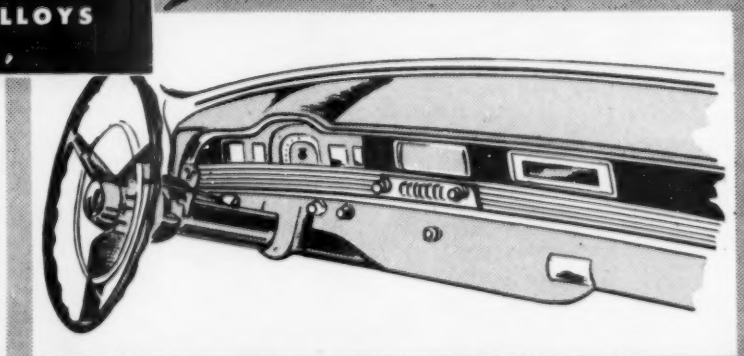
● Zamak (zinc base) Alloys readily lend themselves to production jobs for ornamental castings of complex design. When polished and chrome plated, such castings enhance the appearance of automotive equipment in many ways. Dash board panels, grilles, trim, tail light assemblies, door handles and hood ornaments are only a few of the applications in which Zamak Alloys have proved themselves best suited.



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likely to become a factor. Fortunately with a self-lubricating bearing, abnormally low clearances may be employed. For example, with a bearing on a shaft of ¼" diameter we have used a clearance as low as 0.00025". One such application is for a small electric fan where the customer wanted a very low noise factor for his end product.

Self-Lubricating Bearing Materials - Briefly

An accepted theory of bearing materials is that there should be a differential between same and the shaft. Generally speaking, this applies primarily to the factors of hardness and plasticity. Therefore, a bronze of high purity and quality is so popular. Obviously this is predicated upon the possibility that at some period there will be metal to metal contact between the bearing and the shaft. With the heavy duty, self-lubricating bearing this is no longer axiomatic because of the constantly present "separator" between the shaft and bearing in the form of a thin but continuous oil film on the bearing surface.

The accepted practice of today is to use a bronze bearing rather than one of iron or ferrous base except where bronze as a material no longer meets the specific requirements of the application. An example would be where the unit pressure exceeds the capacity of the bronze bearing.

Sometimes, too, a bronze bearing is desired containing other elements than copper and tin, notably lead. It is immediately apparent that in ordinary casting process due to the difference in melting point and specific gravity, a homogeneous mixture and/or alloy is impossible to obtain. These difficulties are overcome by proper powder metallurgy processing. During World War II, for example, we broke many bottle necks by producing a lead bronze bearing of homogeneous composition. The lead, while providing a desirable plasticity factor, also functions as a solid lubricant which at times is desirable as an additional factor of safety. In the writer's opinion, a great many bearing applications would be well serviced with lead bronze, self-lubricating bearings.

Tolerances

Tolerances are often left to draftsmen and detailers, therefore, may be unnecessarily close or expensive. After all, 0.0002 is but one portion of a human hair that has been split lengthwise in ten or twelve equal parts. Good practice includes rechecking.

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PLUMBING FITTINGS
continued from page 47

14. An adequately accurate hexagon for a wrench grip is cast and does not need machining. The knurling is cast on.

15. By using a brass stem co-operating with the zinc seat, a flat seated valve can be used without having to resort to rubber or fabric gaskets.

Some machining must be done on the casting. Reference to Figure 2 clearly shows how minor this machining is.

The four outlet and inlet holes, Figure 2a, are tapped for ⅛ inch pipe, this operation is done by the foundry making the part. The internal thread on the cap, Figure 2b, is cut by the foundry and matches the large external cast thread. On this same piece, the smaller hole is threaded by Lynn Products Co., Inc. The pointer (Figure 2c) is used as cast.

NEW PRODUCTS
continued from page 110

cent through a 150 mesh screen and about 60 percent through a 325 mesh screen. The powder has a very low surace oxide content, can be molded at from 30 to 50 tsi and sintered at 2100 F using normal sintering times.

The illustration shows some parts made from this powder using essentially standard powder metallurgical techniques for pressing and sintering.

Alloy Metal Powders, Inc.
For more information circlel No. 210 on the Reader Service Card

AIRCRAFT LANDING GEAR
continued from page 33

the investment in the part. Any manufacturing process, then, which lowers both the incidence of defects and the amount of machining that is required, cuts rejects.

To reduce dead weight the aluminum die cast wheels were converted to magnesium die castings.

The castings are made so that all of the machine work that has to be done is either lathe or drill press work. The OD of the rim must be cleaned up and the hole for the bearing machined to take a bearing retainer ring. As can be seen in the illustration, the two castings are fastened together with three bolts. Holes for these bolts are cored, but generally contain a slight flash which must be removed. The bearing retainer plate is fastened with three machine screws.

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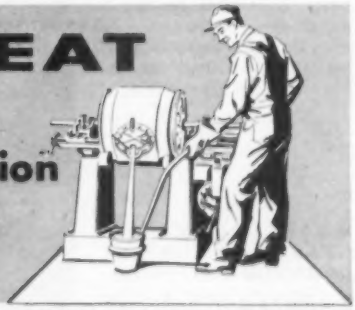

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★ *reduce production costs*

★ *improve product quality*

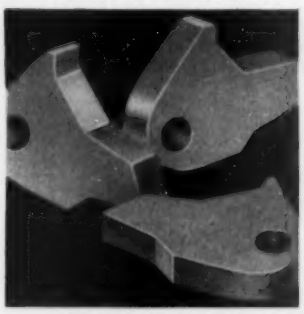
★ *lengthen product life*

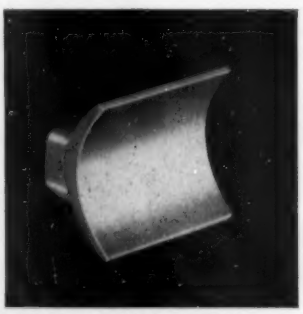
Electrolytic iron powder, as produced by Plastic Metals, is ideally suited for compacting parts where strength, precision, finish and high resistance to wear are prime requirements.

Examples shown on this page illustrate just a few applications where sinterings made from Plastic Metals electrolytic iron powder have proved to be advantageous cost-wise, production-wise and quality-wise. Many other prominent manufacturers are using Plastic Metals electrolytic iron powder with continued success.

Your products may offer opportunities for the profitable use of electrolytic iron powder or other types of metal powders in the making of parts. We can put you in touch with reliable and fully experienced fabricators who will be glad to consult with you and help you to determine whether metal powders are applicable.

IMPELLER BLADES made by Presmet Corporation for flywheel of Westinghouse "Waste-Away" garbage disposer. Electrolytic iron powder sinterings replaced former alloy castings. Costly machining eliminated and product life increased substantially.

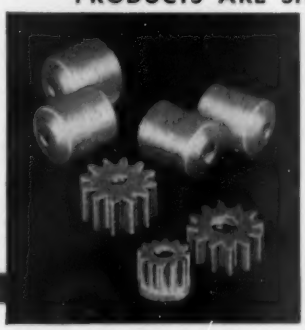


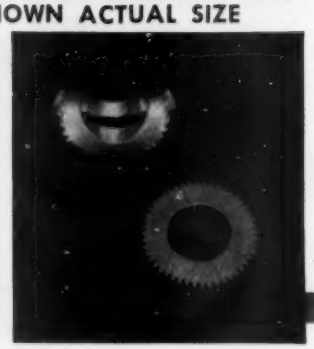


AIRPLANE CONTROL MOTOR POLE PIECE of electrolytic iron powder made by Moraine Products Division of General Motors Corporation. This part required powder of extreme purity and softness for magnetic properties. Electrolytic iron powder provided a high quality product with reduced production costs.

PRODUCTS ARE SHOWN ACTUAL SIZE

MODEL LOCOMOTIVE GEARS AND CURRENT COLLECTOR ROLLERS made of electrolytic iron powder by The Lionel Corporation. Requirements—uniform high purity for electrical conductivity and toughness to withstand hard wear. High density for gears. Precision, longer life and lower cost achieved.





HEAVY DUTY AIRCRAFT INSTRUMENT GEAR made of electrolytic iron powder by Pow-Met Industries, Inc. Note bent specimen demonstrating toughness and ductility prior to heat treatment. After heat treatment, they are capable of obtaining physical characteristics equivalent to heat-treated steels. Observe precision of fine teeth.

PLASTIC METALS

DIVISION OF THE NATIONAL RADIATOR COMPANY
JOHNSTOWN, PENNSYLVANIA

Write to Plastic Metals for further information on the successful usage of electrolytic iron powders.

For additional information Circle No. 74 on the Reader Service Card

Powder Metallurgy Directory continued from page 96

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.

Charles Hardy, Inc.
420 Lexington
New York, N. Y.

Kaiser Aluminum & Chemical Co.
1924 Broadway
Oakland, Calif.

Metals Disintegrating Co.
Box 290
Elizabeth, N. J.

Reade Mfg. Co.
Box F
Lakehurst, N. J.

Reynolds Metals Co.
2500 S. Third
Louisville, Ky.

Wall Colomonoy Corp.
19345 John R.
Detroit, Mich.

BRASS

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.
(80-20, 70-30, 60-40)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(80-20, 70-30, 60-40, 90-10, 85-15, lead bearing)

Metals Disintegrating Co.
Box 290
Elizabeth, N. J.
(80-20, 70-30, 60-40, 85-5-5, 80-10-2, 80-10-10)

New Jersey Zinc Sales Co.
160 Front
New York, N. Y.
(80-20, 70-30, 60-40, 90-10, 85-15, 75-25, 50-50)

COPPER

American Metal Co., Ltd.
61 Broadway
New York, N. Y.
(electrolytic, copper base alloys)

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.
(electrolytic)

Glidden Co.
1396 Union Commerce Bldg.
Cleveland, O.

Greenback Industries, Inc.
Greenback, Tenn.
(sponge)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(electrolytic, atomized spherical)

Malone Metal Powders
Malone, N. Y.
(electrolytic, dendritic)

Metals Disintegrating Co.
Box 290
Elizabeth, N. J.
(sponge, electrolytic, atomized, bronze)

New Jersey Zinc Sales Co.
160 Front
New York, N. Y.
(atomized)

Reade Mfg. Co.
Box F
Lakehurst, N. J.
(flake, grain)

Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

IRON

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.
(sponge, carbonyl)

Easton Metal Powder Co.
233 Broadway
New York, N. Y.
(liquid disintegrated)

Ekstrand & Tholand, Inc.
441 Lexington
New York, N. Y.
(sponge)

Ferrum, Ltd.
506 Ste-Madeleine Blvd.
Cap-de-la-Madeleine
Quebec, Canada
(atomized, decarburized cast iron)

General Dyestuffs Corp.
Antara Chemical Div.
435 W. Hudson
New York, N. Y.
(carbonyl)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(sponge, hydrogen reduced, atomized, electrolytic, carbonyl)

Hoeganaes Sponge Iron Corp.
545 Fifth Ave.
New York, N. Y.
(sponge)

A. Johnson & Co., Inc.
61 Broadway
New York, N. Y.
(electrolytic)

Magnetic Powders, Inc.
Fairview Ave.
Johnsonburg, Pa.
(hydrogen reduced, carbonyl)

Metal Powders, Ltd.
73 Fifth Ave.
Iberville, Quebec, Canada
(sponge, alloys with Cu, Ni, Mo, Mn, etc.)

Metals Disintegrating Co.
Box 290
Elizabeth, N. J.
(sponge, hydrogen reduced, atomized)

National Radiator Co.
Plastic Metals Div.
201 Bridge
Johnstown, Pa.
(sponge, atomized, electrolytic)

Powdered Metals, Inc.
Box 1134
Tacoma, Wash.
(electrolytic)

Pyron Corp.
Box E — LaSalle Station
Niagara Falls, N. Y.
(hydrogen reduced)

LEAD

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.

Glidden Co.
1396 Union Commerce Bldg.
Cleveland, O.

Charles Hardy, Inc.
420 Lexington
New York, N. Y.

Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.

National Lead Co.
111 Broadway
New York, N. Y.

Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

LUBRICANTS

Acheson Industries, Inc.
Acheson Colloids Co., Div.
Port Huron, Mich.
(colloidal graphite, molybdenum disulfide)

American Cyanamid Co.
30 Rockefeller Plaza
New York, N. Y.
(all metallic stearates)

Capital City Products
525 W. First
Columbus, O.
(all metallic stearates)

Foote Mineral Co., Inc.
18 W. Chelten
Philadelphia, Pa.
(lithium stearates)

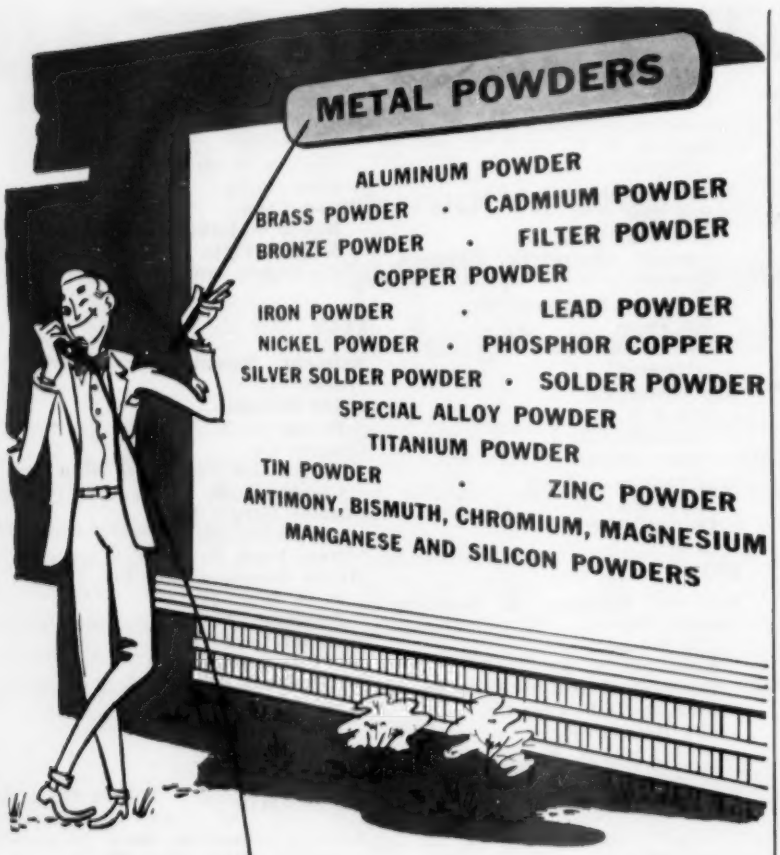
Leffingwell Chemical Co.
P. O. Box 191
Whittier, Calif.
(zinc, magnesium, lithium, calcium stearates)

Metasap Chemical Co.
Lewis & Carter
Harrison, N. J.

Nopco Chemical Co.
First & Essex
Harrison, N. J.
(zinc, magnesium, calcium stearates)

M. W. Parsons-Plymouth, Inc.
59 Beekman
New York, N. Y.
(zinc, lithium, calcium stearates)

Whittaker, Clark & Daniels, Inc.
260 West Broadway
New York, N. Y.
(aluminum, calcium, lithium stearates)



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Elizabeth B • New Jersey

MD PRODUCTS
METAL POWDERS
METAL PIGMENTS
METAL ABRASIVES
Since 1916

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Elizabeth, N. J.; Manchester, N. H.; Berkeley, Calif.; Emeryville, Calif.

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WORLD'S LARGEST MANUFACTURER OF FINELY DIVIDED METALS

For additional information Circle No. 69 on the Reader Service Card

Whitco Chemical Co.
260 Madison
New York, N. Y.
(zinc, calcium stearates)

NICKEL

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.
Charles Hardy, Inc.
420 Lexington
New York, N. Y.
Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.
National Radiator Co.
Plastic Metals Div.
201 Bridge
Johnstown, Pa.
New Jersey Zinc Sales Co.
160 Front
New York, N. Y.
Reade Mfg. Co.
P. O. Box F
Lakehurst, N. J.
Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

STEEL

Carbon and low alloy

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
Metal Powders Ltd.
73 Fifth Ave.
Iberville, Quebec, Canada
National Radiator Co.
Plastic Metals Div.
201 Bridge
Johnstown, Pa.
Vanadium-Alloys Steel Co.
Latrobe, Pa.
Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

High Alloy

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
Metal Hydrides, Inc.
20 Congress
Beverly, Mass.
Vanadium-Alloys Steel Co.
Latrobe, Pa.

Stainless

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
Uniworld Research Corp. of America
1302 Ontario
Cleveland, O.
Vanadium-Alloys Steel Co.
Latrobe, Pa.
Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

TIN

American Metal Co., Ltd.
61 Broadway
New York, N. Y.
Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.

Greenback Industries, Inc.
Greenback, Tenn.

Charles Hardy, Inc.
420 Lexington
New York, N. Y.

Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.

National Lead Co.
111 Broadway
New York, N. Y.

Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

ZINC

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.

Charles Hardy, Inc.
420 Lexington
New York, N. Y.

Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.

New Jersey Zinc Sales Co.
160 Front
New York, N. Y.

Wall Colmonoy Corp.
19345 John R
Detroit, Mich.

MISCELLANEOUS METALS

American Metal Co., Ltd.
61 Broadway
New York, N. Y.
(lead-tin solder)

Fansteel Metallurgical Corp.
North Chicago, Ill.
(carbides, tungsten, molybdenum)

Firth Sterling, Inc.
3113 Forbes
Pittsburgh, Pa.
(carbides)

General Electric Co.
Carboloy Dept.
Edmore, Mich.
(carbides)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(most other metals)

Metal Hydrides, Inc.
20 Congress
Beverly, Mass.
(pre-alloyed powders for addition to iron, produced to specification)

Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.
(most other metals)

National Radiator Co.
Plastic Metals Div.
201 Bridge
Johnstown, Pa.
(manganese, silicon, ferro-alloys)

New Jersey Zinc Sales Co.
160 Front
New York, N. Y.
(eutectic phos-copper, pre-alloyed bronze)

Reade Mfg. Co.
P. O. Box F
Lakehurst, N. J.
(magnesium, silver alloys)

Sylvania Electric Products Co.
Tungsten & Chemical Div.
Box 70
Towanda, Pa.
(tungsten)

Vanadium-Alloys Steel Co.
Latrobe, Pa.
(tool steel, high temperature alloys)

Wall Colmonoy Corp.
19345 John R
Detroit, Mich.
(nickel-chromium-boron alloy)

Welded Carbide Tool Co.
60 Colfax
Clifton, N. J.
(carbides)

continued next page

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Whatever may be your requirements in POWDER METALLURGY Watertown can handle them with rare precision. Excellently equipped plant and laboratory for complete physical testing help insure your getting the kind of part you want.
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77 PORTER STREET, WATERTOWN, CONN.

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3rd annual

POWDER METALLURGY DIRECTORY

SECTION 3

Alphabetical Listing

COMPONENTS FABRICATORS

Adamas Carbide Corp.
Kenilworth, N. J.
(cemented carbides)

American Brake Shoe Co.
Sintermet Dept.
Hillburn, N. Y.
(friction materials)

American Electro-Metal Corp.
320 Yonkers
Yonkers, N. Y.
(bearings, structural parts, magnetic materials, sintered carbides)

American Sinterings Div.
Engineered Plastics, Inc.
Box 69
Watertown, Conn.
(bearings, electrical components, structural parts)

Amplex Mfg. Co.
Subsidiary of Chrysler Corp.
6501 Harper
Detroit, Mich.
(bearing, structural parts, cores, magnetic materials, friction materials, electrical components, heavy metal)

Asco Sintering Co.
7799 Telegraph
Los Angeles, Calif.
(bearings, structural parts, magnetic materials, electrical components, filters)

Bound Brook Oil-less Bearing Co.
Lincoln Blvd.
Bound Brook, N. J.
(bearings, structural parts)

Brockway Pressed Metals, Inc.
Brockway, Pa.
(bearings, structural parts)

Capitol Mfg. Corp.
22nd & Hervey
North Chicago, Ill.
(bearings, structural parts)

Ceromet, Inc.
417 W. Chestnut
Monrovia, Calif.
(bearings, structural parts, magnetic materials, electrical components)

Chicago Powdered Metal Products Co.
9700 Waveland
Schiller Park, Ill.
(bearings, structural parts, electrical components)

Henry L. Crowley Co., Inc.
1 Central
West Orange, N. J.
(bearings, structural parts, cores, magnetic materials, electrical components)

Detroit Sintered Metals Corp.
18434 Fitzpatrick
Detroit, Mich.
(bearings, structural parts magnetic materials, electrical components)

Dixon Sintaloy, Inc.
535 Hope
Stamford, Conn.
(bearings, structural parts, contact materials, friction materials, electrical components, filters)

Eaton Mfg. Co.
9771 French
Detroit, Mich.
(carbides, cermets)

Fansteel Metallurgical Corp.
North Chicago, Ill.
(contact materials, heavy metal)

Ferro Powdered Metals, Inc.
Salem, Ind.
(bearings, structural parts)

Firth Sterling, Inc.
3113 Forbes
Pittsburgh, Pa.
(bearings, structural parts, contacts, cemented carbides)

Ford Motor Co.
Dearborn General Mfg. Div.
Plastics & Machining Plant
Dearborn, Mich.
(bearings, structural parts)

General Electric Co.
Carboloy Dept.
Edmore, Mich.
(structural parts, magnetic materials, thermistors)

General Metals Powder Co.
130 Elinor
Akron, O.
(friction materials)

General Powdered Metal Products, Inc.
523 West Ave.
Norwalk, Conn.
(bearings, structural parts, magnetic materials, electrical components)

General Sintering Corp.
3907 Wesley Terrace
Schiller Park, Ill.
(bearings, structural parts, cores, magnetic materials, electrical components)

Gibson Electric Co.
8436 Frankstown
Pittsburgh, Pa.
(contact materials, electrical components)

Indar Corp.
2215 Alvord
Indianapolis, Ind.
(bearings, structural parts, cores, magnetic materials, electrical components)

International Powder Metallurgy, Inc.
439 W. Main
Ridgway, Pa.
(bearings, structural parts)

Indiana Steel Products Co.
Valparaiso, Ind.
(magnetic materials)

Johnson Bronze Co.
500 Mill
New Castle, Pa.
(bearings, structural parts)

Keystone Carbon Co.
State Street
St. Marys, Pa.
(bearings, structural parts, magnetic materials, contact materials, electrical components)

Kwikset Powdered Metal Products
516 Santa Ana
Anaheim, Calif.
(bearings, structural parts, electrical components)

Lux Clock Mfg. Co.
Waterbury, Conn.
(bearings, structural parts)

Magnetic Core Corp.
2 Croton
Ossining, N. Y.
(cores, electrical components)

P. R. Mallory & Co., Inc.
3029 E. Washington
Indianapolis, Ind.
(contact materials)

Merriman Bros.
185 Amory
Jamaica Plain
Boston, Mass.
(structural parts, electrical components)

Metal Powder Products, Inc.
Logan, O.
(bearings, structural parts, magnetic materials, electrical components)

Metallic Friction Material Co.
5400 W. 130
Cleveland, O.
(friction materials)

Michigan Powdered Metal Products Co., Inc.
466 Cady
Northville, Mich.
(bearings, structural parts, magnetic materials, electrical components)

Micro Metallic Corp.
30 Sea Cliff
Glen Cove, N. Y.
(filters)

Moraine Products Div.
General Motors Corp.
1420 Wisconsin Blvd.
Dayton, O.
(bearings, structural parts, friction materials, electrical components)

National Molded Products, Inc.
40-42 S. St. Marys
St. Marys, Pa.
(bearings, structural parts)

National Moldite Co.
1410 Chestnut
Hillside, N. J.
(cores)

Permag Corp.
214 Taaffe
Brooklyn, N. Y.
(magnetic materials)

Powdercraft Corp.
746 Hayne
Spartanburg, S. C.
(bearings, structural parts, magnetic materials, friction materials, electrical components)

Powder Metal Products Co.
500 St. Marys
St. Marys, Pa.
(bearings, structural parts)

Pow-Met Industries
1460 Cincinnati
Dayton, O.
(structural parts, electrical components)

Precision Metal Products
Commerce St., Box 129
Ellwood City, Pa.
(bearings, structural parts)

The Presmet Corp.
112 Harding
Worcester, Mass.
(bearing, structural parts, magnetic materials, friction materials)

Pyroferric Co., Inc.
621 E. 216
New York, N. Y.
(cores)

Radio Cores, Inc.
9540 Tulley
Oak Lawn, Ill.
(cores)

Raybestos-Manhattan, Inc.
61 Willett
Passaic, N. J.
(friction materials)

Reese Metal Products Corp.
537 Howard
Lancaster, Pa.
(bearings, structural parts, electrical components)

Sintercast Corp. of America
134 Woodworth
Yonkers, N. Y.
(carbides)

Sintered Metals, Inc.
3390 Washington
Jamaica Plain
Boston, Mass.
(bearings, structural parts, magnetic materials, contact materials, electrical components)

Speer Carbon Co.
Speer Resistor Div.
Theresia St.
St. Marys, Pa.
(cores, contact materials)

Stackpole Carbon Co.
Tannery St.
St. Marys, Pa.
(cores, magnetic materials, contact materials, friction materials)

Superior Carbon Products
9115 George
Cleveland, O.
(bearings, structural parts, contact materials, electrical components)

Symmco, Inc.
Sykesville, Pa.
(structural parts)

Thompson Products, Inc.
Metallurgical Products Div.
23555 Euclid
Cleveland, O.
(structural parts)

United States Graphite Co.
Div. of Wickes Corp.
1621 Holland
Saginaw, Mich.
(bearings, structural parts, electrical components)

Wakefield Bearing Corp.
29 Foundry
Wakefield, Mass.
(bearings, structurial parts, friction materials, electrical components)

Watertown Mfg. Co.
217 Echo Lake
Watertown, Conn.
(bearings, structural parts, elecctrical components)

Welded Carbide Tool Co.
62 Colfax
Clifton, N. J.
(hot pressed carbide shapes, heavy metal)

S. K. Wellman Co.
200 Egbert
Bedford, O.
(friction materials)

Yale & Towne Mfg. Co.
Powdered Metal Products Div.
9335 W. Belmont
Franklin Park, Ill.
(bearings, structural parts, cores, electrical components)

POWDER SUPPLIERS

Acheson Industries, Inc.
Acheson Colloids Div.
Port Huron, Mich.
(colloidal graphite, molybdenum disulfide)

Aluminum Co. of America
1501 Alcoa Bldg.
Pittsburgh, Pa.
(aluminum)

American Cyanamid Co.
30 Rockefeller Plaza
New York, N. Y.
(metal stearates)

American Metal Co., Ltd.
61 Broadway
New York, N. Y.
(copper, tin, solder, copper base alloys)

Belmont Smelting & Refining Works
330 Belmont
Brooklyn, N. Y.
(all metals)

Capital City Products
525 W. 1st
Columbus, O.
(metal stearates)

continued next page

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Our business is powder metal parts: Good ones. We have heavy experience in engineering and producing them to both military and civilian specs. If you want straight-forward counsel on the design of a powder metal part . . . or the conversion of a part to powder metal, you'll find Capitol a good place to bring your problem. Try us and see.

Capitol manufacturing

22nd and Hervey Ave., North Chicago, Ill.

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Easton Metal Powder Co.
233 Broadway
New York, N. Y.
(iron)

Ekstrand & Tholand, Inc.
441 Lexington
New York, N. Y.
(iron)

Fansteel Metallurgical Corp.
North Chicago, Ill.
(tungsten, molybdenum)

Ferrum Ltd.
506 Ste-Madeleine Blvd.
Cap-de-la-Madelaine, Quebec, Can.
(iron)

Firth Sterling, Inc.
3113 Forbes
Pittsburgh, Pa.
(low alloy, high alloy, stainless steels, tungsten carbides)

Foote Mineral Co., Inc.
18 W. Chelten
Philadelphia, Pa
(metal stearates)

General Dyestuffs Corp.
Antara Chemical Div.
435 W. Hudson
New York, N. Y.
(carbonyl iron)

General Electric Co.
Carboloy Div.
Edmore, Mich.
(carbides)

Glidden Co.
1396 Union Commerce Bldg.
Cleveland, O.
(copper, lead)

Greenback Industries, Inc.
Greenback, Tenn.
(copper, tin)

Charles Hardy, Inc.
420 Lexington
New York, N. Y.
(all metals and alloys)

Hoeganaes Sponge Iron Corp.
545 Fifth Ave.
New York, N. Y.
(iron)

A. Johnson & Co., Inc.
61 Broadway
New York, N. Y.
(iron)

Kaiser Aluminum & Chemical Co.
1924 Broadway
Oakland, Calif.
(aluminum)

Leffingwell Chemical Co.
P. O. Box 191
Whittier, Calif.
(metal stearates)

Magnetic Powders, Inc.
Fairview Ave.
Johnsonburg, Pa.
(iron)

Malone Metal Powders
Malone, N. Y.
(copper)

Metal Hydrides, Inc.
20 Congress
Beverly, Mass.
(pure metals and alloys)

Metal Powders, Ltd.
73 Fifth Ave.
Iberville, Quebec, Can.
(iron, iron alloys, carbon steel)

Metals Disintegrating Co.
P. O. Box 290
Elizabeth, N. J.
(all metals and alloys)

National Lead Co.
111 Broadway
New York, N. Y.
(lead, tin)

National Radiator Co.
Plastic Metals Div.
201 Bridge
Johnstown, Pa.
(iron, nickel, plain carbon steel, manganese, silicon, ferro-alloys)

New Jersey Zinc Sales Co.
160 Front
New York, N. Y.
(copper, brass, bronze, zinc, nickel silver)

Nopco Chemical Co.
First & Essex
Harrison, N. J.
(metal stearates)

M. W. Parsons-Plymouth, Inc.
59 Beekman
New York, N. Y.
(metal stearates)

Pyron Corp.
Box E, LaSalle Station
Niagara Falls, N. Y.
(iron)

Reade Mfg. Co.
P. O. Box F
Lakehurst, N. J.
(copper, aluminum, nickel silver, magnesium, silver alloys)

Reynolds Metals Co.
2500 S. 3rd
Louisville, Ky.
(aluminum)

Sylvania Electric Products Co.
Tungsten & Chemical Div.
Box 70
Towanda, Pa.
(tungsten)

Uniworld Research Corp. of America
1320 Ontario
Cleveland, O.
(stainless steel)

Vanadium-Alloys Steel Co.
Latrobe, Pa.
(plain carbon, low and high alloy steel, stainless steel)

Wall Colmonoy Corp.
19345 John R.
Detroit, Mich.
(copper, tin, zinc, aluminum, lead, stainless steel, carbon steel)

Welded Carbide Tool Co.
62 Colfax
Clifton, N. J.
(carbides)

Whittaker, Clark & Daniels, Inc.
260 W. Broadway
New York, N. Y.
(metal stearates)

Witco Chemical Co.
260 Madison
New York, N. Y.
(metal stearates)

EQUIPMENT BUILDERS

Adamas Carbide Corp.
Kenilworth, N. J.
(carbide dies and tools)

Ajax Electrothermic Corp.
Ajax Park
Trenton, N. J.
(furnaces, fuel and electric)

L. Albert & Son
Trenton, N. J.
(presses, mixing equipment)

Allied Chemical & Dye Corp.
Barrett Div.
42 Rector
New York, N. Y.
(anhydrous ammonia)

Alloy Engineering Co.
100 Mill
Berea, O.
(sintering trays)

American Metaseal Mfg. Corp.
607 65th
West New York, N. J.
(impregnating equipment and impregnants)

American Steel Foundries
Elmes Engineering Div.
1150 Tennessee
Cincinnati, O.
(hydraulic presses)

Anglo American Mill Corp.
Owensboro, Ky.
(mixing equipment)

Apothecaries Hall Co.
Meadow & Benedict
Waterbury, Conn.
(anhydrous ammonia)

Armour & Co.
Ammonia Div.
1353 W. 31
Chicago, Ill.
(anhydrous ammonia)

R. N. Bailey & Co., Inc.
11 W. 42
New York, N. Y.
(mixing equipment, industral and laboratory screens)

Baker Perkins, Inc.
1000 Hess
Saginaw, Mich.
(mixing and blending machines)

Baldwin-Lima-Hamilton Corp.
Philadelphia, Pa.
(mechanical and hydraulic presses)

Barber-Coleman Co.
Wheelco Instruments Div.
1300 Rock
Rockford, Ill.
(pyrometers, thermocouples and supplies)

E. W. Bliss Co.
1375 Raff, S. W.
Canton, O.
(mechanical and hydraulic presses)

Henry Bower Chemical Mfg. Co.
2900 Gray's Ferry Rd.
Philadelphia, Pa.
(anhydrous ammonia)

Brill Equipment Co.
2401 Third Ave.
New York, N. Y.
(mechanical and hydraulic presses, electric and fuel fired furnaces, mixing equipment, screening equipment)

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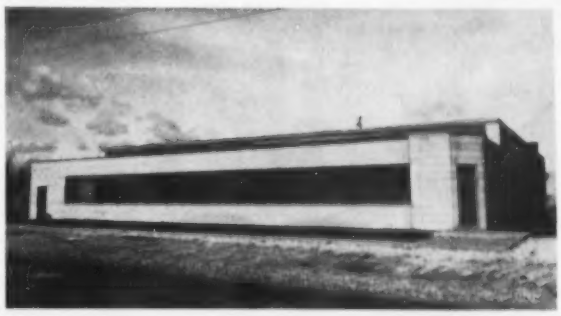

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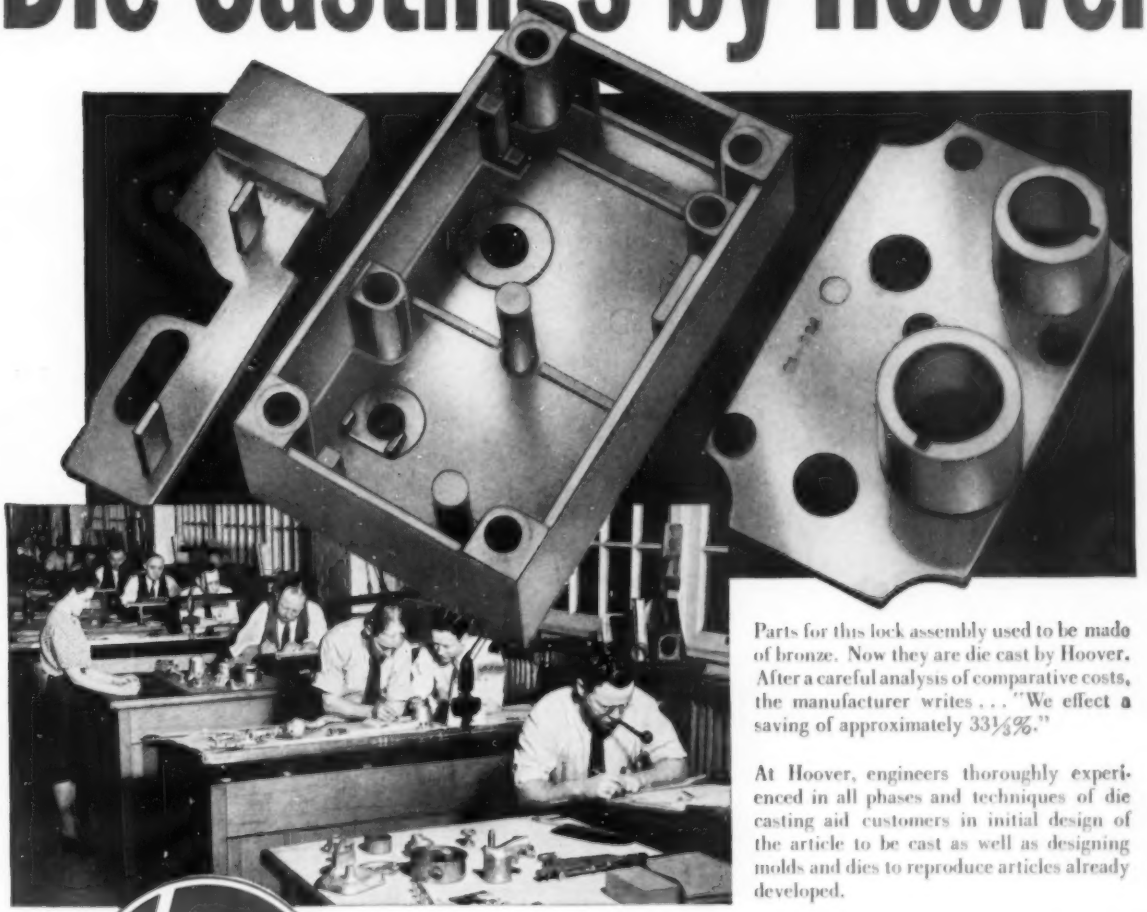

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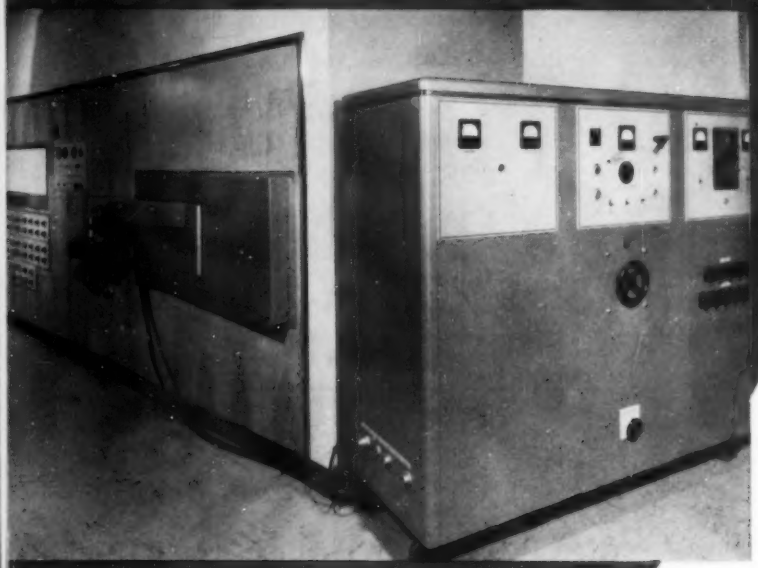

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